THE AEROPLANE and ASTRONAUTICS

AUGUST 26, 1960

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ONE SHILLING
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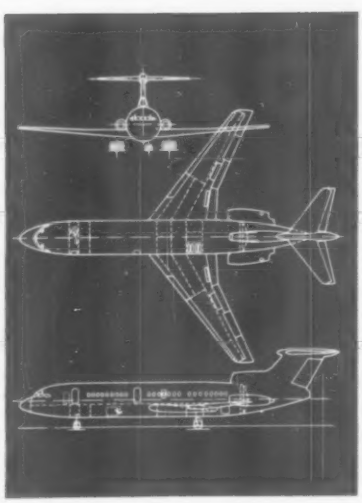

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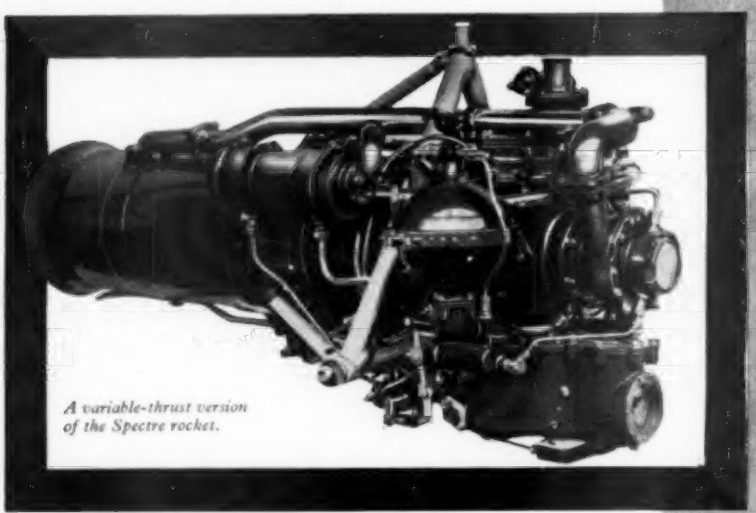
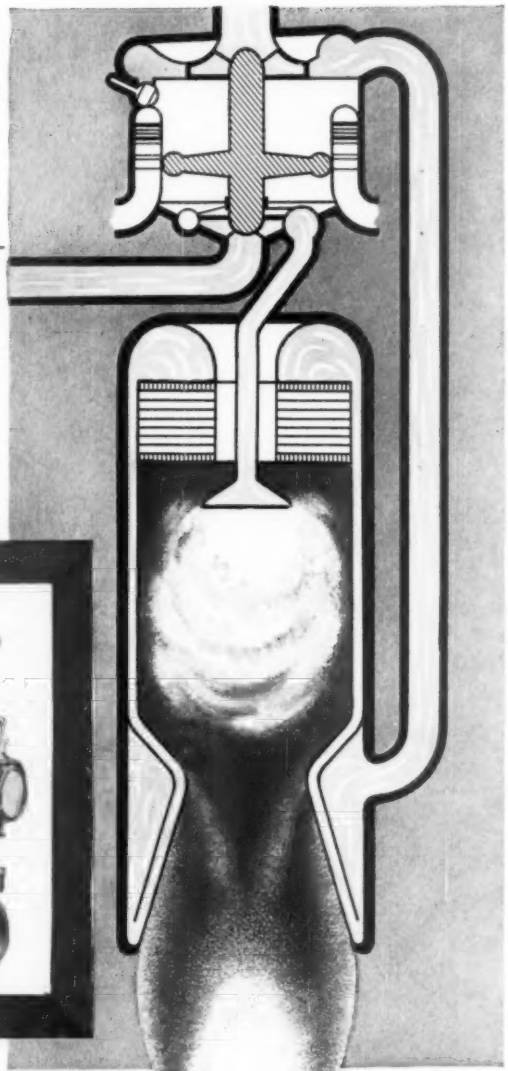


A variable-thrust version of the Spectre rocket.



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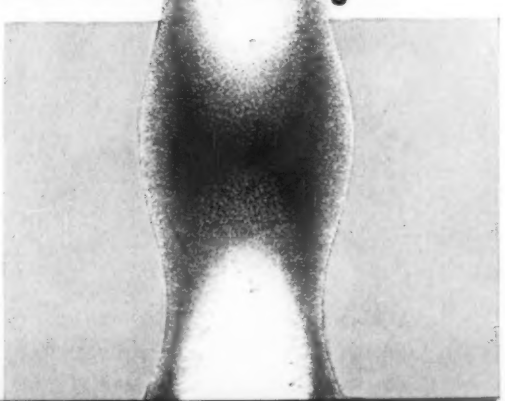

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STAND No. 275

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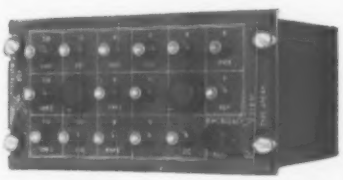

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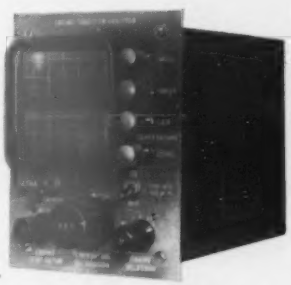

A variant, Engine Vibrator Indicator Type UE 920, is also being shown. This instrument displays vibration information quantitatively on four moving-coil instruments. Excessive vibration operates warning lamp.

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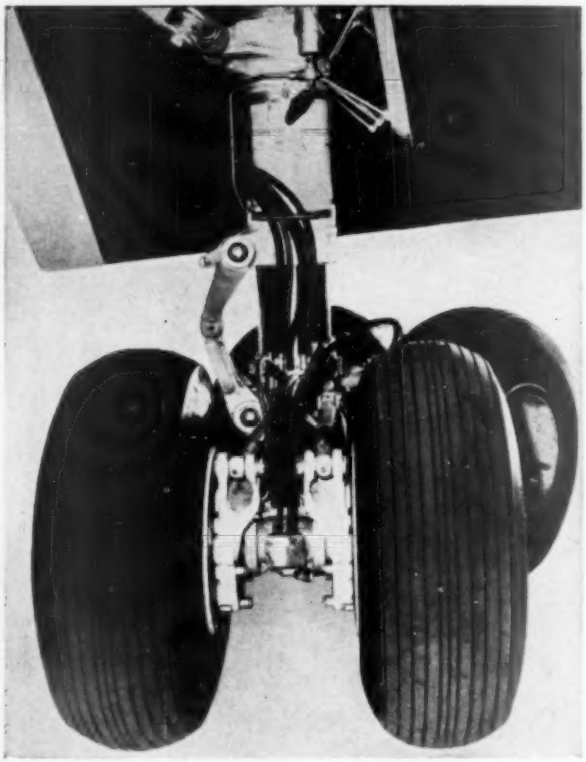

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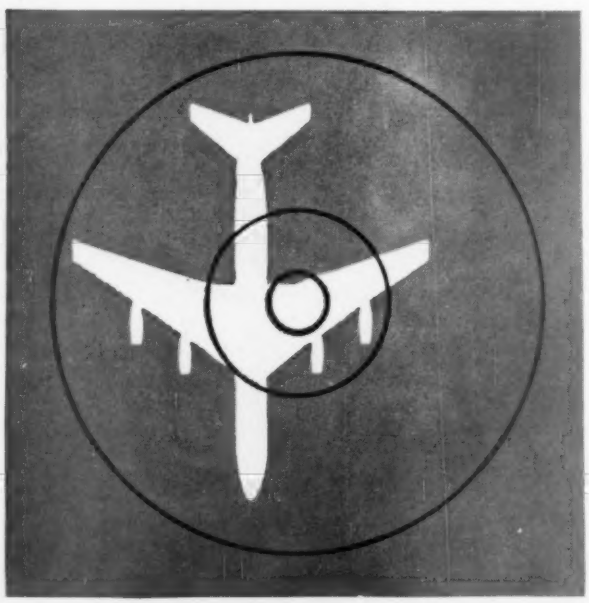

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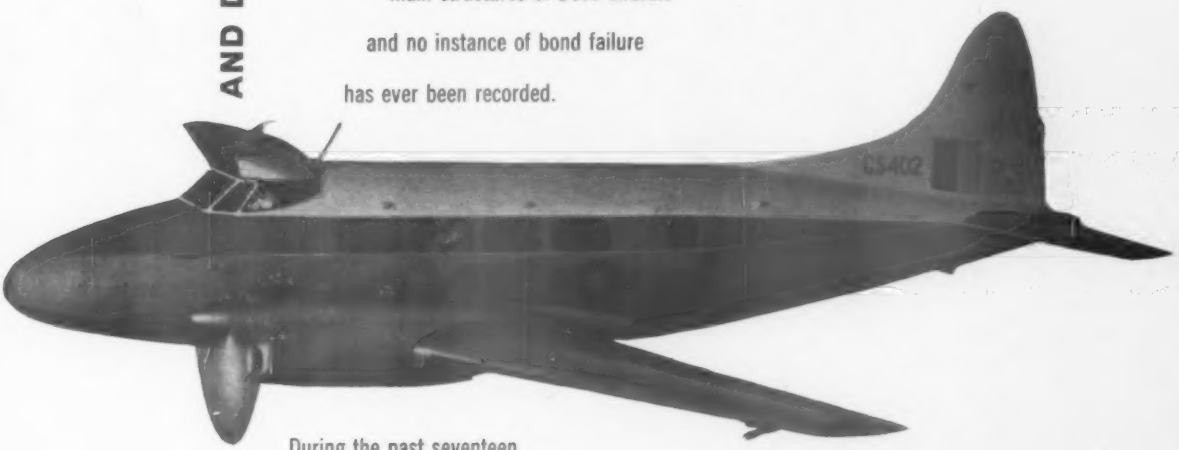
DURABILITY AND DE HAVILLAND



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PYE

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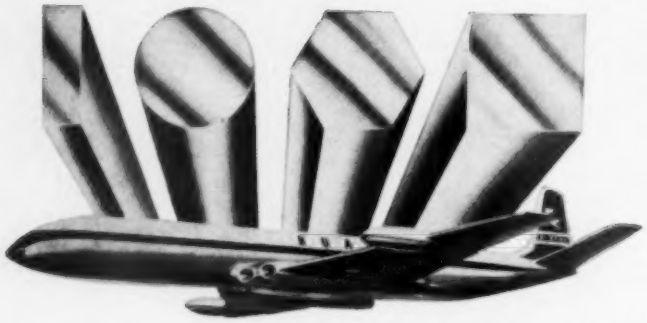

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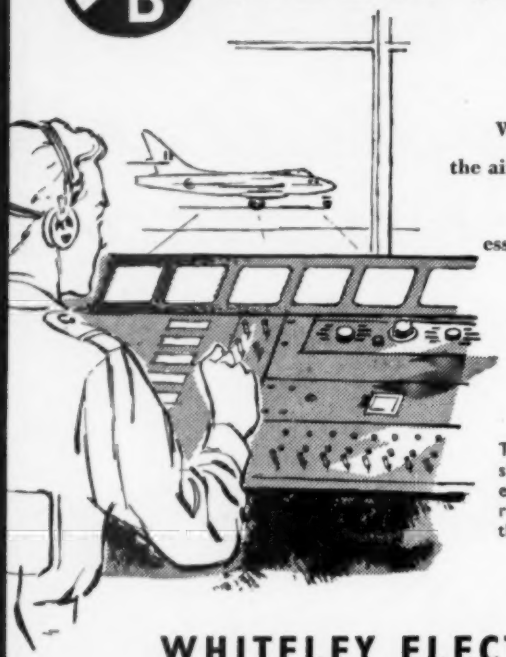

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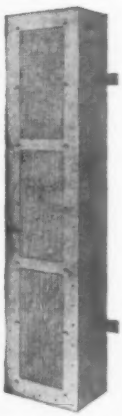

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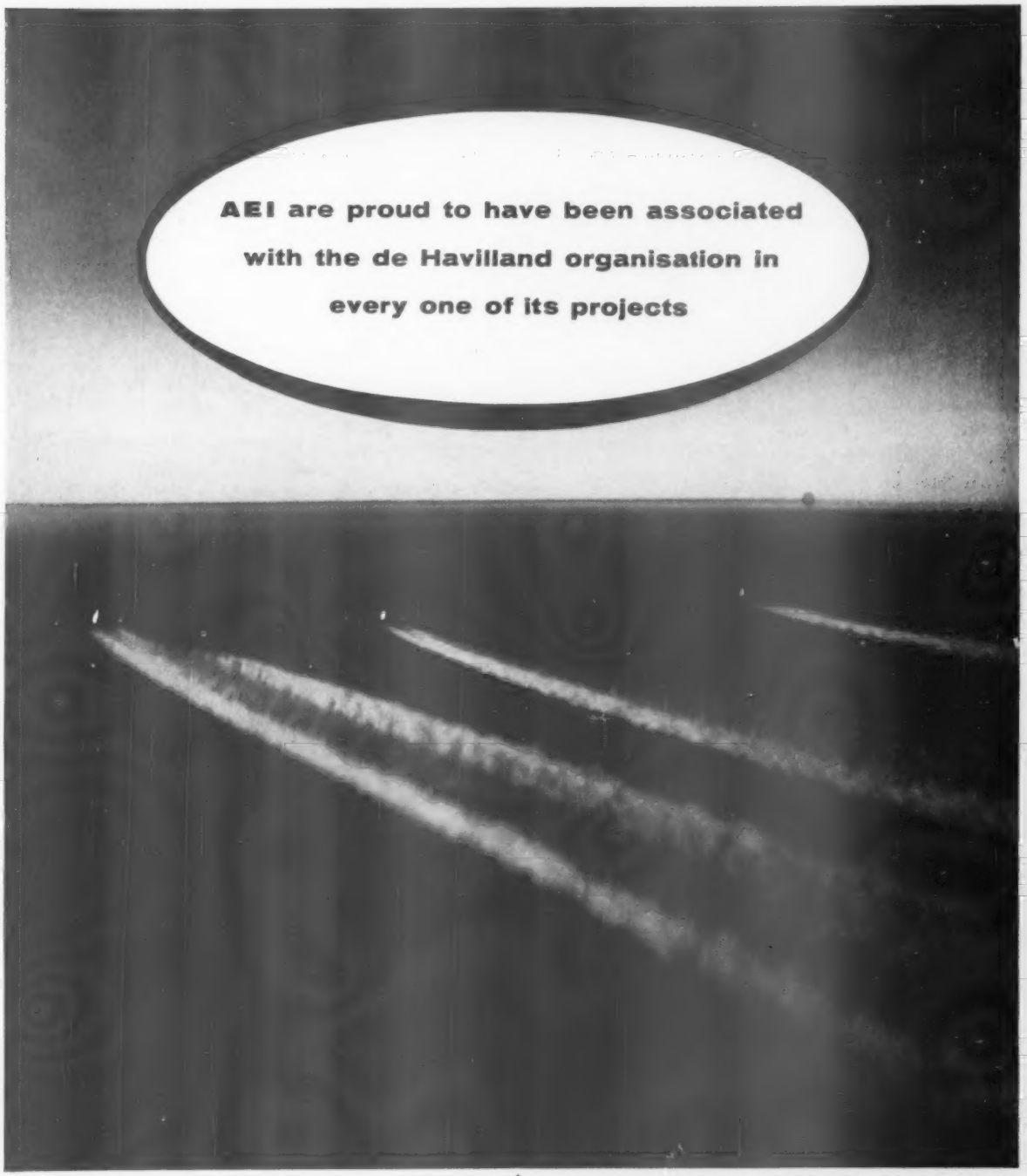

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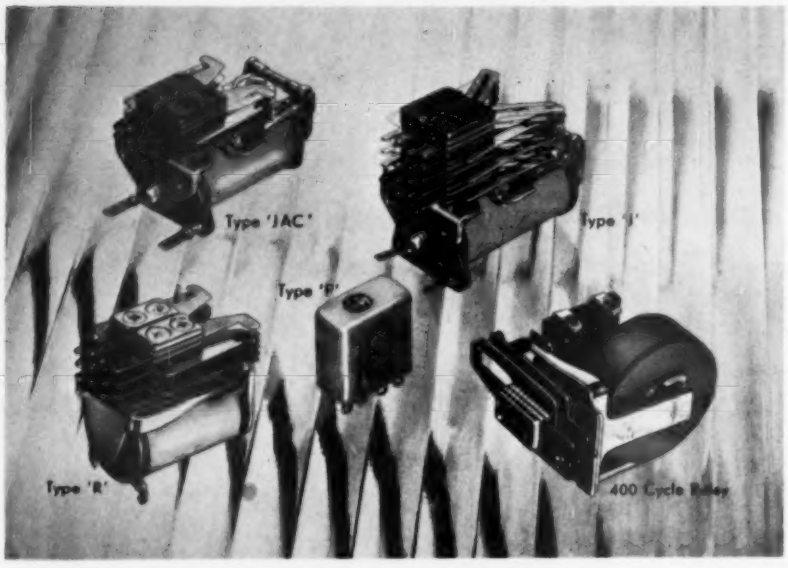

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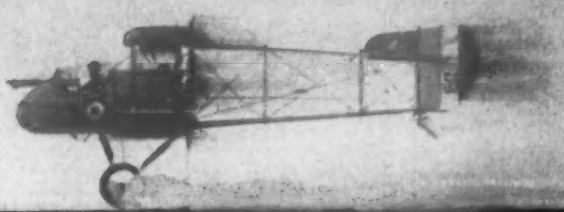

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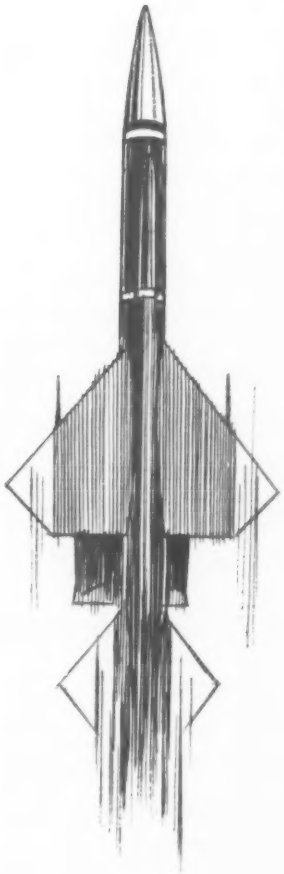

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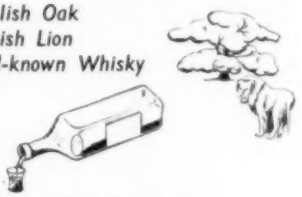

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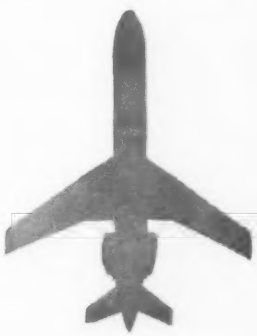

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on the occasion of their

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ROLLS-ROYCE

THE AEROPLANE and ASTRONAUTICS

VOLUME 99 NUMBER 2549 AUGUST 26, 1960

A Royal Aerospace Society?

A ballot is being taken of the members of the Institute of Aeronautical Sciences with a view to changing the name of the twenty-eight-year-old American counterpart of the R.Ae.S. to the Institute of AEROSPACE Sciences. In an editorial of the latest issue of the I.Ae.S. magazine the director, S. Paul Johnston, has explained why.

He writes that to make its official title consistent with its professional objectives and activities, the Council of the Institute of the Aeronautical Sciences, meeting in the Ambassador Hotel in Los Angeles, Jne. 29, 1960, voted unanimously to submit a name change to the IAS membership for approval. It recommended that the now universally accepted word "Aerospace" be substituted for the word "Aeronautical" in the title by which the Institute has been known since 1932. If the membership concurs, the organization will become officially the "Institute of the Aerospace Sciences." The long-established and familiar "IAS" designation will remain unchanged.

The editorial records that this history-making session of the Council was attended by members from all over the United States. President Donald L. Putt presided. Present also were many Past Presidents of the Institute, including James H. Doolittle, Hugh L. Dryden, Arthur E. Raymond, Hall L. Hibbard, Clark B. Millikan, John K. Northrop and L. B. Richardson. The Council action was the result of a resolution proposed by IAS Vice-President Harold Luskin on behalf of the Combined IAS Regional Advisory Committees which had convened the preceding day.

Later in the editorial Mr. Johnston points out that for IAS purposes, the compound term is important. In addition to the technical aspects of space travel, many IAS members are vitally involved in problems concerning the advancement of travel and national defence within the Earth's atmosphere. There are many problems yet to be solved in such areas, both in military and in commercial fields. These matters are of great concern to the IAS as the professional society in the aerospace field.

* * *

What a contrast to this forthright American declaration appears when one studies the implications of the word "space" as used in the vocabulary of some learned men in this country. It is something that many of them seem to think we have no need to worry much about. There is even a discernible inclination to be grateful for permission to mount British scientific equipment in American or Russian space probes.

Responsibility for this attitude of mind cannot be entirely avoided by those who have accepted the burden of leading aeronautical thought in this country. Has the time not come for the Royal Aeronautical Society to question its policies in this matter? Is the Council of that body satisfied that it is giving a sufficiently vigorous lead in these matters? Is there not a considerable proportion of its membership which would welcome some outward sign of the Society's interest in aerospace engineering?

The founders of the I.Ae.S. have paid generous tribute in the past to the inspiration they have received from the Royal Aeronautical Society. Is it too much to hope that the R.Ae.S. will see that now is the time to take reciprocal action?

D

Editor THURSTAN JAMES
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Matters of Moment

Co-ordination of Attack

A SINGLE director of strategic target planning has been appointed by the U.S. Secretary of Defense, Mr. Thomas Gates. General Thomas Power is to have this responsibility for co-ordination of all the U.S. strategic nuclear forces. Mr. Gates described his action as "the most important decision I have participated in since I have been in the Pentagon." It marks a compromise in a long-standing disagreement between the U.S.A.F. and the U.S. Navy.

The U.S.A.F. has argued that all nuclear deterrent weapons, including Polaris, should come under a single operational command, preferably Strategic Air Command; the Navy has fought to retain control over Polaris operations.

Under the new arrangement Gen. Power will continue to be commander of S.A.C. But the new target-planning organization will be subject to the direction of the Joint Chiefs of Staff, and Polaris submarines will not come under the direct control of Gen. Power.

The object of the new organization is to ensure that U.S. retaliatory weapons—bombers and land- and submarine-based missiles—can be co-ordinated and launched at previously earmarked targets within as little as 15 minutes after warning of an attack. In the past it has been felt that there might be duplication of effort if two independent Services were responsible for nuclear missiles.

The plan is geared to a shift of emphasis from bombers to land- and sea-based missiles. Gen. Power is expected to complete his first integrated target list and submit it to the Joint Chiefs of Staff by December.

Brought Back Alive

FIRST recovery of living creatures from space was claimed by Russia on Aug. 20. They had been launched the day before in Sputnik V, a satellite virtually identical to Sputnik IV whose recovery had been unsuccessfully attempted last May.

Sputnik V weighed 4,600 kg. (10,141 lb.) and was launched into a near-circular orbit at a height of 320 km. (199 miles) and with an inclination of 65°. It made one circuit every 90.6 minutes. The vehicle was described as the "second cosmic spaceship" and carried insects, plants, seeds, mice, rats and two dogs, Strelka and Belka, with all the necessary life-support equipment. Television equipment was used to observe the behaviour of the animals while in orbit. During orbital flight under conditions of weightlessness the pulse and breathing rates of the dogs were reported to be "within the bounds of normal fluctuations."

On Aug. 21 it was announced in Moscow that Sputnik V had been brought back safely to Earth on its 18th circuit, and that the dogs were in "good condition." "The space ship and, separated from it, the capsule with experimental animals, landed successfully." During re-entry "the control system and braking device functioned with great precision and ensured the landing of the ship in the pre-set area." The landing was made less than seven miles from the selected point. It came about 27 hours after the satellite was launched. Insulation kept the cabin temperature below 30° C. (86° F.) during re-entry.

Information about the behaviour of the dogs shows that they had different reactions to their experience. Belka's pulse rate was originally 75; it rose to 160 during the launch but settled back to 72 after a few minutes. Her breathing rate rose from 24 to 240 and came right back to 12 when in orbit. For Strelka the pulse rate figures were respectively 90, 160 and 65, and breathing rates, 60, 160 and 125.

Back-pedalling on Air Policy

Sir Roy Fedden, M.B.E., Hon. F.R.Ae.S., Hon. F.I.A.S., writes:—

FARNBOROUGH, Britain's annual aeronautical shopping week, being less than two weeks away, and a new Minister of Aviation having just been announced only nine months after this important Government post was created, it would seem an opportune time to take stock of the causes which have led up to the stalemate on the most important single factor in the whole of Britain's economy, and from there proceed to constructive suggestions for its early cure.

To put AIR at the top of the list might appear superficially to be overstating the case, but an unbiased investigation will show that it is no exaggeration, as this argument applies both in Peace and War. It is the most important branch of our defence. It will eventually put all other forms of passenger and freight transport in the shade and it needs the most highly disciplined form of engineering.

This entails a balanced, virile aircraft industry and modern Government Research Departments. From all these stem new ideas and techniques which enable us to lead in traditional forms of engineering and thus make our mark in various types of industrial engineering exports which are our life blood.

The career of an aeronautical engineer can be one of the most satisfying in this country. This has already been proved by our many successes in the past. It requires a high degree of mental alertness and technical skill linked to relatively insignificant quantities of raw material which exactly fits our resources and economy. It will not, however, be an assured profession unless the British public make the AIR their prime concern, are prepared to take their part in it, and will contribute towards making Britain great and important in the AIR AGE just as their forebears did in the mercantile marine age.

To do this needs moral fibre, enthusiasm and willingness to tighten our belts and make sacrifices as Prince Philip so aptly told his audience at the Festival Hall when talking to the Youth of Britain on space exploration.

What a challenge to the nation to grapple with what is in fact fast developing into a crisis, which, if neglected, will determine the future existence of Britain as a World power. This country should rise to the occasion therefore and urge the new Minister to tackle the problem in a way in which it can have faith.

Three years ago my book entitled "Britain's Air Survival"

STRUCTURAL SKIN.—Large machined skin panels with window and emergency exit cut outs, are used in the Vickers VC10, for parts of the fuselage. Such a single skin, immediately over the wing torsion box, is here in position in the fuselage erection jig.

FIRST DOWN.—Left, Gen. Thomas White, Chief of Staff of the U.S.A.F., and Lt. Gen. Bernard Schriever, head of the Air Force Research and Development Command, examine the capsule from Discoverer XIII.

was published which made an appraisement of how matters stood in the AIR and offered a plan for the future.

Much has happened since then including the rationalization of the Industry at the beginning of this year by the past Minister of Aviation and a promise of new orders from the Government which has not yet matured. The tempo of World aeronautics and astronautics has increased at an even greater rate than expected but the Government and industry are still endeavouring to work out a plan with the outmoded administrative machinery and methods of 1940, and without one voice on the importance of the task, and what is within our scope.

Over the past 20 years the aeronautical engineering field has expanded nearly five times.

Up to the present time the engineering and scientific staffs of Britain and the Commonwealth have been able to keep pace with this staggering speed of advance, and have made a number of outstanding contributions.

How long this state of affairs can last it is hard to say, when they see the hesitation and indecision of the powers that be in settling on a 10-year long-term plan for the future in the AIR, or in taking the necessary steps that will give confidence that they mean what they say and will see it through.

It does not help to hear the Cabinet is taking advice on our air policy from theoretical scientists whose background is not even aeronautics or from elder statesmen who have been out of touch with the practical side of their own particular activity for many years, let alone having had no experience of modern post-war aircraft manufacture.

It does not carry confidence for civil servants and industrialists who a few years back allowed our country to attempt to compete with U.S.A. and U.S.S.R. in far too great a diversity of new types, and signally failed to effectively cope with correct timing and checking of costs, to be again relied upon for our new long-term aeronautical plan.

The British aircraft industry have done very well on exports over the last decade, but during the next few years they may well fall to less than half the 1959 figures, because for three critical years, the M.o.S. failed to place any orders worth speaking about. Owing to the time factor for new types, nothing we can do about it now can improve the position until after 1964.

There are so many crossings of lines and self-interested aspirations on this question of the AIR which today are as prevalent in Government departments as in industry, that the new Minister must have completely independent, down-to-earth facts. These should not be served up to him to suit a particular theory, or temporary whim, or to give some branch of the industry a financial advantage.

We should insist on the Minister obtaining unbiased advice from practical engineers with long experience of planning ahead and throwing up pitfalls, and not from theoretical scientists or elder statesmen in the background.

The most practical way of doing this is to adopt a plan along lines suggested in my book, by setting up an independent high-level Tribunal briefed by technicians who have no loyalties except to the Country and the Commonwealth. In short a modernized Finletter Commission to plan a realistic programme for the AIR which will literally enable us to remain a sufficiently powerful member of the Free World, whose opinion will be heeded.

Facts about Discoverer

NEW information on the 300-lb. Discoverer capsule which has been successfully recovered from orbit on two occasions was given at the Stockholm Astronautical Congress by R. P. Haviland of General Electric, the capsule manufacturer.

After completion of the satellite mission, usually on the 17th passage about the Earth, the satellite is oriented for re-entry at a backward angle of 60°. This was illustrated in THE AEROPLANE AND ASTRONAUTICS on Aug. 19. To achieve the necessary ejection accuracy, a timer in the satellite is corrected by radio-command on the basis of the orbital parameters, the re-entry signal being transmitted from a station in Alaska.

Separation of the capsule from the Agena satellite is achieved by firing explosive bolts and the capsule is then immediately spun up by two small rocket motors to provide re-entry stability. Finally, in quick succession, the re-entry rocket is fired. This converts the flight path from a circular orbit to a re-entry ellipse. These events occur close to the North Pole.

On the re-entry trajectory, the capsule continues to travel to the south, but at a steadily decreasing altitude. As it approaches Hawaii, re-entry into the atmosphere occurs and the nose-covering of the ablation cone is "washed away" by the intense heat. At this stage, the capsule can be observed from the ground as an artificial meteor. The air also becomes a conductor of electricity, so that radio contact with the capsule is temporarily lost.

Here it must be emphasized that the entire re-entry takes place without gas-jet orientation purely by spin-stabilizing the capsule. The whole re-entry programme lasts less than five minutes, and during this period, the capsule slows from satellite velocity, over 17,000 m.p.h., to just below the speed of sound. At the end of re-entry, it is dropping almost vertically.

At a height of 50,000 ft., a parachute is released to reduce still further its rate of descent to about 35 m.p.h. To achieve this, the back fairing falls free and the internal payload package is pulled out of the outer nose-cone to make its leisurely descent. Flashing lights, a radio beacon and marker dye which stains the water yellow-green are used to help locate the capsule if the patrolling C-119 transports do not catch it in mid-air. Although the package has space for carrying a mouse or monkey, only test instruments were carried in Discoverers XIII and XIV.

In the near future it is proposed to orbit, Mr. Haviland said, an American-born rhesus monkey. The monkey would be strapped down on a moulded foam-rubber couch, similar to that for the astronaut in the Mercury capsule, and would be free to move its hands to take food from an automatic dispenser. In view of the Russian achievement with Sputnik V, it was hoped to go ahead as soon as possible.

Later, with increasing accuracy and reliability, he said, it was planned to achieve recovery of capsules over land to eliminate the standing patrol of recovery aircraft.

On Aug. 19, the capsule from Discoverer XIV was successfully recovered in the air by a C-119 Fairchild Packet using the air-snatch technique of trailing trapeze-like nets. A number of critics of this scheme will now have cause to eat their proverbial hats, as will the present writer.—K.W.G.

A Turbine Pioneer

DR. A. A. GRIFFITH, C.B.E., D.Eng., F.R.S., the chief scientist to Rolls-Royce, Ltd., has retired after 21 years with the company, but will still act as a consultant to it.

A leading pioneer of the gas turbine, Dr. Griffith formulated new theories of compression and turbine design when he was at the R.A.E. and in 1926 proposed an axial-flow gas turbine engine for aircraft which he claimed would be lighter, smaller and more efficient than piston engines. Sir Frank Whittle's work on jet propulsion began in 1928; his adoption of the relatively simple centrifugal compressor allowed quicker short-term development of the turbojet engine, but Dr. Griffith's belief in the superior efficiency of the axial-flow compressor was eventually vindicated, although the first Rolls-Royce turbojets, the Derwent and Nene, had centrifugal compressors.

In the early years of the War Dr. Griffith led Rolls-Royce gas-turbine investigations. The first Rolls-Royce turbojet with an axial compressor, the Avon, was based on a technical memorandum he prepared in 1945. In 1946 he first put forward proposals for a by-pass engine.

Nineteen years ago he forecast the possibility of vertical take-off using high-thrust axial turbojets and it is nearly 10 years since he first proposed the slim-delta jet-lift supersonic airliner. To quote Mr. Rubbra, technical director of Rolls-Royce, "Throughout his career, Dr. Griffith has usually looked 15 or 20 years ahead. His influence will continue as long as gas turbine aero engines are used, for they all incorporate some of his original thinking."

I.A.F. Congress Report

NOT altogether surprisingly, last week's Congress of the International Astronautical Federation in Stockholm was accompanied by a series of outstanding space-achievements. The meeting opened on Aug. 15 on a wave of triumph for the Americans with the recovery of a 300-lb. Discoverer capsule, the launching of the 100-ft. "balloon" satellite Echo, and record performances by the rocket-powered X-15 research aircraft. Another capsule—from Discoverer XIV—returned safely to Earth on Aug. 19. Then to cap it all, the Russians sent into orbit, and brought back safely, two dogs in the life compartment of Sputnik V.

Held this year under the auspices of the Swedish Interplanetary Society, the 11th I.A.F. Congress was the largest meeting of its kind ever held and drew to Sweden's capital more than 800 participants from all parts of the World. In the Soviet party, which numbered seven, were Prof. L. I. Sedov, chairman of the Interplanetary Commission of the U.S.S.R. Academy of Sciences, Prof. A. Blagonravov, Prof. A. Mikhailov and Prof. V. Krasovsky. A number of Russian papers were given describing results of experiments with the Sputniks and Luniks, but until Sputnik V burst upon the proceedings on Aug. 19 there were few details of future plans.

Main lecture sessions, symposia, and business sessions of the I.A.F. Council, were held in a spacious lecture theatre and various halls in the extensive *Kungl, Tekniska Högskolan* (Royal Institute of Technology). Three large rooms were set aside for exhibitions which included several U.S. Navy small soundings rockets, a scale model of the Hawker Siddeley Communications satellite, and a full-scale cutaway model of the American Tiros weather satellite. Also included were diagrams and photographs of the Avco arc-jet rocket engine and others illustrating the enterprising Kappa rocket programme being carried out by Tokyo University. A scale model of the host Society's Aurora sounding rocket project, intended to use the Swedish-built VR3 H_2O_2/kerosene rocket engine in the first stage, was also shown.

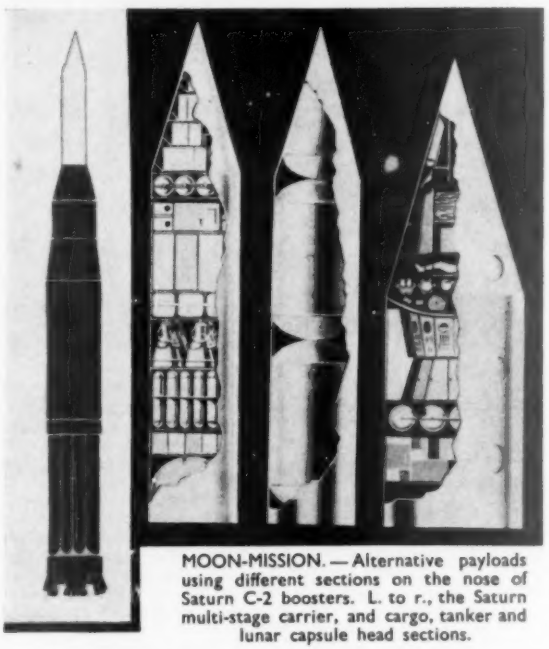
The day before the conference ended, a duplicate of the re-entry capsule of Discoverer XIV was flown in specially from Philadelphia, complete with payload package and parachute.

The Congress Opens

Official opening of the Congress took place at Stockholm's China Theatre on Aug. 15, where more than 1,000 people were addressed by Prof. Sedov, Dr. R. W. Porter and Sir Harrie Massey, who gave the inaugural lecture.

Prof. Sedov (President of the I.A.F.) spoke of the many problems that had yet to be faced in space-development and said there were growing opportunities for meteorology and radio communication with Sputniks. A programme for the re-entry of Earth satellites was in progress and there was hope for a fast and positive solution. (Less than four days later the Russians dotted the i's and crossed the t's of Prof. Sedov's remarks by launching Sputnik V.) It was also possible, he said, to look forward to the application of atomic and electromagnetic propulsion systems.

Dr. Porter followed by expressing greetings from the Committee on Space Research (COSPAR), of which he, Prof. Blagonravov and Sir Harrie Massey are leading figures.



MOON-MISSION.—Alternative payloads using different sections on the nose of Saturn C-2 boosters. L. to r., the Saturn multi-stage carrier, and cargo, tanker and lunar capsule head sections.

Appearance of Sir Harrie Massey at the Congress was a particular surprise for British delegates and was taken as a sign of growing co-operation between COSPAR and the I.A.F. A large part of his lecture was concerned with stressing the need for international co-operation between nations in sounding the upper atmosphere. He believed it would be 100 years before the atmosphere below a height of 100 km. (62 miles) was fully "worked out" by scientific investigation and no satellite could perform this job. Thus there would be scope for scientists all over the World even if no vehicle which could ascend above 100 km. were available.

Sir Harrie also spoke of the desirability of continuing scientific research with artificial satellites and of extending investigation to the Moon and the nearer planets by rocket probes. He said he was full of admiration for the rocket engineers who were offering proofs of scientific theory by direct observation.

Next day, technical sessions began at the K.T.H. when an

IN STOCKHOLM.—(Left) Prof. A. Blagonravov, Prof. L. I. Sedov, F. C. Durant, III, Dr. Wernher von Braun, and Prof. Theodor von Kármán. (Right) Mr. S. R. Dauncey, Hawker Siddeley, with Dr. W. F. Hilton only British contributors to the main I.A.F. lecture session. Their joint paper dealt with "Communications Satellite Orbits."

attentive audience heard Dr. Wernher von Braun speak on the "United States Space Carrier Vehicle Programme."

Few British Papers

After von Braun, the main stream of Congress proceedings began in earnest with double and sometimes triple technical sessions. Well over 100 papers were presented, the majority by representatives of the American rocket industry. Although there were more than 40 British participants in the Congress, there was only one British paper in the main sessions—that of Dr. W. F. Hilton and S. R. Dauncey of Hawker Siddeley on "Communications Satellite Orbits"—and two in the Space-Medicine Symposium, these from the R.A.F. Institute of Aviation Medicine, Farnborough. Flt. Lt. J. C. Guignard dealt with "Human Frequency Response to Vibration" and Flt. Lt. J. Billingham considered the heat loads on pressure cabins during re-entry under the title, "Control of Microclimate Temperature in Very Hot Environments."

This meagre showing was directly attributable to the Government's long-delayed decision on Blue Streak and Britain's future in space-development, which prevented the British Interplanetary Society from obtaining certain key papers.

Apart from the Space Medicine Symposium, there was an interesting and well-attended Symposium on Small Sounding Rockets, and an Astrodynamics Colloquium. The third Colloquium on the Law of Outer Space was held in the Appollonia Congress Hall in another part of the city on Aug. 16.

In addition to all this, it was possible to drop in at film shows and, on one occasion, the writer was fortunate enough to hear Mrs. Goddard, wife of the late Robert H. Goddard, commenting on film sequences showing some of her husband's pioneer rocket experiments in New Mexico. Other interesting films dealt with the Tiros meteorological satellite and the McDonnell space-capsule.

Plenary Sessions

While technical sessions were in progress, delegates of some 30 member-societies of the I.A.F. were meeting under the chairmanship of Prof. Sedov. One of the first items to gain approval in the plenary sessions was the Academy of Astronautics, for which Prof. Theodor von Kármán and Dr. Eugene Sänger have worked for many years.

However, before the vote was taken, Prof. Sedov rose to say that the Russians would not be joining the Academy as they did not feel that adequate progress had been made in international collaboration in space-research. There were, he pointed out, three separate bodies to be considered, the I.A.F., COSPAR and the U.N. Committee of the Peaceful Uses of Outer Space. The same argument, he said, would apply to the Institute of Space Law, which the I.A.F. Council also approved with the Russian delegate abstaining.

Despite this, however, it was noted that the name of Prof. Sedov appeared among a list of names of distinguished scientists who will be concerned in a study group set up by the Academy. Prof. von Kármán described him as "a friend of the Academy." This group is proposing to investigate the problems of establishing a manned laboratory on the Moon under the LIL project, short for Lunar International Laboratory. Consideration will be given to a whole range of related subjects, including materials, power generation, artificial atmosphere supply and human factors.

The subject is considered to be ideally suited for preliminary study by scientists and engineers of all nations. It may do much to put manned space exploration on a truly international footing in the future.

In addition to the LIL project, it has been decided to establish a money prize to be awarded for the best paper submitted on any astronautical subject each year. There would be equal opportunity for the distinguished scientist and the enterprising student. This award has been made possible by a grant of $75,000 from the Guggenheim Foundation, which will support the Academy for the first three years. Headquarters of the Academy will be in Paris, accommodation having been made available by the French Government. The same premises are expected to be used by the I.A.F. Secretariat.

At the final plenary meeting on Aug. 19, the I.A.F. Council unanimously elected Prof. Sedov to a second term of office as President. Vice-Presidents elected were Dr. H. Seifert (U.S.A.), Dr. L. R. Shepherd (U.K.), Prof. R. Pěsek (Czechoslovakia), Prof. J. Péres (France) and Obering F. Staats (German Federal Republic). Secretary remains for the present Ing. J. Stemmer (Switzerland) and General Counsel Mr. A. G. Haley (U.S.A.).

New York in 1961

Next year, for the first time, the I.A.F. Congress moves across the Atlantic to New York. It will be organized by the American Rocket Society in October, 1961. With the vast reservoir of American rocket and space-technology to draw upon, those attending are expected to reach several thousands.

What achievements are in store for discussion at next year's meeting are, of course, matters for conjecture, but it is not unreasonable to assume that the first astronaut will be the guest of honour. K.W.G.

Von Braun on Orbital Refuelling

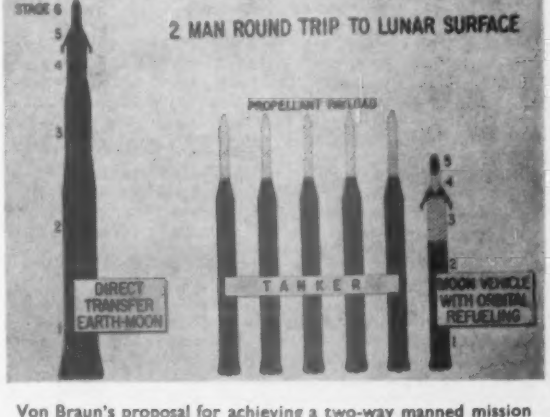
AN excellent appraisal of the Saturn Project, looking forward over a 10-year development period, was given by Dr. von Braun at the I.A.F. Conference. After describing the configuration of the three-stage C-1 and the four-stage C-2 versions of the huge booster, he went on to outline some of the applications which have been proposed for the C-2 in terms of manned space-flight.

Of particular interest was his description of a two-man expedition to the Moon, making use of orbital techniques to accomplish a mission that would otherwise require the services of a much larger launching vehicle (of about 12M. lb.s.t.). The proposal, he said, was to launch five unmanned tanker rockets into a staging orbit around the Earth for the purpose of refuelling a sixth vehicle which would be sent out to rendezvous with them. The idea of breaking down a space-mission in this way is, in fact, far from new, and very similar vehicle proposals were made by the British Interplanetary Society some 10 years ago.

To accomplish refuelling, von Braun stressed the necessity of developing a reliable orbital rendezvous technique. Orbiting working crews, trained to perform certain functions under zero-*g* conditions, would be needed to connect the Moonship and tanker and transfer propellents from the latter to the former. The limited time period for the whole operation may demand a substantial number of Saturn launch pads on Earth. Apart from the all-important human needs, limitations on time caused by the orbital storage of hydrogen over extended periods between individual tanker flights may be a serious factor. If this should prove decisive, he said, lower energy storable propellents may have to be used for the Moonship, thereby increasing the number of tanker flights by 50%.

Dr. von Braun derived the following conclusions from the rival approaches of direct transfer versus orbital refuelling for manned lunar and planetary missions: (a) the orbital refuelling method may permit the missions to be realized sooner; (b) the direct transfer method may be cheaper but almost certainly will come later, and (c) the orbital transfer vehicles would be more reliable, but the direct transfer would be a less complex operation.

Consideration was also being given to the orbiting of a manned space-station to act as a rendezvous base for the tanker rockets engaged in refuelling operations. It would also serve as temporary quarters for the space crew needed to transfer propellent from one vehicle to another. Using the same refuelling technique, it was also possible to send a shortened version



Von Braun's proposal for achieving a two-way manned mission to the Moon with Saturn C-2 refuelling the outgoing space vehicle from five tanker rockets in orbit around the Earth.

of the space-station into a circumlunar trajectory to permit close observation of the Moon's surface.

Preliminary estimates indicate that such a vehicle would weigh about 15,000 lb. including 6,000 lb. for a re-entry capsule, instruments and controls, for the return into the Earth's atmosphere. This capsule might well be fitted with lifting devices for use during the re-entry manœuvre prior to the time the parachutes were deployed. In addition to the 6,000-lb. re-entry capsule, 4,000 lb. would be devoted to the "caboose" section of the space-vehicle which would contain the scientific payload, crew, supplies, etc. Finally, von Braun said, some 5,000 lb. would be allocated to combination abort and mid-course control, and possibly a re-entry deceleration propulsion system.

Saturn Testing and Soviet Boosters

So far in the test programme of the Saturn booster at the Marshall Space Flight Center, von Braun said eight firings had been conducted; there had not been a single deficiency in any of the eight engines. Asked to give his opinion of the thrust of the Soviet rocket booster responsible for launching the Lunik vehicles, von Braun said it was generally agreed to be around 700,000 lb.—about twice that of Atlas. Prof. Mikhailov, the distinguished Soviet astronomer, who was also on the platform, was asked if he would confirm this, much to the general amusement.

Little, in fact, emerged at the Congress about Russia's future plans apart from that implied by Sputnik V which was in marked contrast to the very thorough run-down on the future American programme given by von Braun and other speakers. Details of progress with the Saturn booster; the single-chamber Rocketdyne F-1 engine of 1.5 million lb. s.t., and the time schedules for space-projects stretching into the second half of the 1960s, were freely available, as were dimensions and capacities of the entire C-1 and C-2 Saturn boosters. This, of course, is in keeping with well-established American traditions, but it clearly gives the Russians the advantage in shaping their own efforts to ensure that they remain ahead.

Professor Mikhailov, who was largely responsible for interpreting the Lunik III pictures of the Moon's hidden face, said in answer to questions that he hoped it would soon be possible to repeat the experiment under different conditions of illumination.

Questioned about the possibility of obtaining similar photographs of Mars, he said the great difficulty was that the position of Mars was not known with sufficient accuracy in kilometres; it was hoped to refine the orbits of Mars and Venus by radar measurements before embarking on such experiments.

From the propulsion point of view, von Braun said Atlas-Centaur should be capable of sending a probe vehicle to Mars, which might be able to enter the atmosphere and send back information. However, manned missions were in a different category. It was impossible to miniaturize man, and one would not want to send only two or three men on a mission of this kind. When everything was considered, the figures for a manned mission to Mars were of "staggering" proportions. However, by the time we were ready for this, he thought nuclear rockets would be available for upper stages of the transport vehicles and the "fuel bill" would be significantly reduced. K.W.G.

Britain, Space and American Rockets

MUCH informal discussion took place between delegates at the I.A.F. Congress on the prospects of Britain entering into space development with the Blue Streak and Black Knight. Many of the Americans thought it important for Britain to have an independent programme in which other European and Commonwealth nations could join.

Alternative proposals that we should use American launching vehicles are, nevertheless, far from imaginary. Apparently, NASA has been reviewing the possibility of "rotating" back to the United States the Thor IRBM's now at operational sites on the East Coast of England for conversion into three-stage Thor-Deltas. These would be offered to the United Kingdom for launching British-built satellite equipment. (A joint U.S./Canadian agreement already provides for the orbiting of the Canadian Top-Side Sounder satellite using one of the 12 Thor-Delta rockets on regular order. An alternative scheme might be to allow Britain to adapt the Thor IRBM's with home-built top stages (e.g., the Saunders-Roe Black Knight).

While the Government still ponders its decision, other nations are becoming more active in space-research. For example, the Italian Committee for Space Research has reached an agreement with NASA for the supply of six Nike-Asp sounding rockets and two Scout rockets of the type the Americans will use to put our satellite instruments into orbit next year. It is proposed to establish a site in Italian Somaliland for launching Scout vehicles into equatorial orbits. Also there are plans for developing the area as an international base for orbiting small scientific satellites. In addition, it is expected that the Mercury tracking site, originally scheduled for Zanzibar, will be established in Italian Somaliland.

Obsolescent "Hardware"

There was general agreement that if we elect to use American vehicles, and scrap our own, we should be cutting ourselves off from a whole future of technological experience. Apart from the fact that it would deprive us of the opportunity of developing our own rocket technology, use of what in American eyes is already an obsolescent rocket would seriously limit the growth potential of any space-programme based upon it.

On the other hand, it was pointed out that with Blue Streak, we have the opportunity not only of up-rating the engines, increasing the propellent capacity by a simple parallel extension of the existing tank structure but, being a larger rocket than Thor with approximately double the initial thrust, it could readily accommodate heavier top stages. With development, an up-rated Blue Streak with LO_2/LH_2 top stages should have no difficulty in approaching the payload capability of Atlas-Centaur. Thus, in contrast with the few hundred pounds which could be orbited by Thor-Delta, it would be possible to extend our payload to 4,000-5,000 lb. in the latter half of the present decade.

However, this would only be possible if we made firm plans for the future and put in hand at least small-scale development of LO_2/LH_2 rocket engines and their related pumps and auxiliary equipment. There would be little value in acquiring a missile of limited capability as a financial expedient, converting the launching sites at Woomera from Blue Streak to Thor capability, only to discover a few years later that we should like to orbit much heavier payloads.

With Blue Streak, it would be unnecessary to acquire larger vehicles as our needs developed. The same basic rocket together with the same basic launching facilities would serve the needs of an expanding space-programme which could satisfy both the needs of the scientist and the applications engineer for many years to come.

On the other hand, if we were to adopt American launching vehicles, would it be reasonable to expect the Americans to help us become their own competitors in such a potentially profitable field as telephone relay satellites? Although it might be expedient for American companies to sell us their unwanted rockets, can we assume that we should be able to use them at Woomera to exploit fields other than those of pure research?

In any event, whether we launch from Australia or the United States, we should be dependent on an uncertain supply of launching vehicles and in the latter case, would have to fit in with already crowded launching schedules. If we wish to develop our own military satellites, nothing less than Woomera launching would appear to be feasible if we are to retain any semblance of political autonomy.

In Stockholm there was considerable surprise among delegates—not least the American—that the scientific view should have been allowed to cloud these wider issues, and broad agreement was expressed with the B.I.S. recommendations for a Euro-Commonwealth space-programme. Far from discouraging the use of our own vehicles, most American observers seemed to think that the entry of other nations into space should be encouraged. Whereas the U.S. programme had been developed rather hastily after the advent of Sputnik I in October, 1957, other nations starting afresh and largely indifferent to "prestige" considerations could afford to spend time in seeking more economic avenues of development which, in the end, would be to the benefit of all.

A European Meteorological Centre?

Advice given by one leading communications engineer was that it might be advisable for Britain to choose one particular project, and concentrate on this. For example, there was an obvious need for a World Meteorological Centre, and this could readily be taken over as a European project. Only two meteorological satellites would be needed to provide this service, and satellite systems offering long-life and high reliability still had to be developed. To provide an up-to-the-minute weather information service on a global scale, it would be necessary to provide an efficient system of data reduction and distribution. These were problems to which the U.K. and associated nations might well apply their efforts; the work would not only be economically worth while but would have the greatest international importance. K.W.G.

Reconnaissance Secrets from Moscow

Facts Sifted from the U-2 Evidence

SPARSE details of U.S.A.F. reconnaissance techniques when operating Lockheed U-2s over the Soviet Union emerged last week during the Moscow trial of Francis Gary Powers, who was shot down on such a mission on May 1 some 1,200 miles inside Russian territory. Powers, who was sentenced, by the Russian court, to imprisonment for 10 years for espionage, had little alternative to his plea of guilty at the opening of his trial on Aug. 17, his 31st birthday, but supplied the essential minimum of information during his public interrogation.

In the indictment was the claim that, on the orders of the Soviet Government, the U-2 was shot down "with the very first shot" of a rocket when flying at about 65,000 ft. over the Sverdlovsk area. Powers confirmed this when under examination by saying that he was at about 68,000 ft. and had just finished making a turn when he heard and felt "a hollow-sounding explosion" to the rear and saw an orange flash.

From the American pilot's evidence, the following overall picture could be drawn. After leaving the U.S.A.F., Powers signed a contract in 1956 with the Central Intelligence Agency to fly along the Soviet border and pick up radio and radar information, for which he was to receive the equivalent of £900 per month. He actually received £535, less tax, £360 being withheld until the successful completion of the contract. The contract, which included 18 months' overseas service, was confirmed after extensive medical and barometric tests, including the fitting of a high-altitude pressure suit.

During training in the U.S.A. for this job, Powers assumed the name of Palmer, and was then sent to "Detachment 10-10" at Incirlik, Adana, Turkey, on about Aug. 20, 1956. This detachment had the job of collecting information along the borders of the Soviet Union, undertaking weather research, and sampling the air for radioactivity. Although commanded by military persons, most of the personnel were civilian, including seven pilots. Weather research was done for NASA (the National Aeronautics and Space Administration) and the weather service.

Powers claimed to have no contact with NASA, to which his unit was officially subordinated, except for a document issued to give him authority to fly military aircraft. In reply to a Russian deposition concerning the lack of national identity markings on the wreckage of the U-2, the American pilot said that it was at Incirlik for some months and every aircraft there had some sort of marks.

All flights appeared to have been made at very high altitudes, and the normal procedure was to breathe pure oxygen for several hours before take-off. The American pilots were told that there was no danger of encountering Russian fighters at their altitude, and the U-2s carried no special device to see attacking aircraft except for a downward-pointing periscope to detect fighters underneath. Before take-off, a special device for jamming radar stations and signals given by fighters and air-to-air rockets was switched on to function throughout the flight.

Other U-2 Flights

In 1956, the U.S. authorities appeared mainly interested in the Black Sea area, and U-2 flights were usually made from Incirlik, via Van, Teheran, to the south of the Caspian Sea, south of Meshed, crossing the Iran-Afghan frontier, and along the Soviet-Afghan frontier. Pilots usually turned back not far from the eastern frontier of Pakistan, although, later, the return began earlier after penetrating about 200 miles into Afghan territory. American interest then moved to the East, while, in addition to these types of flights, Powers ferried U-2s from Adana to Bodoe, Norway, by an unspecified route in August, 1958, and from Gibelstadt, W. Germany, to New York. At Bodoe, he thought, two U-2 (reconnaissance) flights were made.

On Apr. 27 this year Powers was flown in a U.S.A.F. transport aircraft from Incirlik to Peshawar, Pakistan, via Bahrain, with Col. Shelton (who was commander of the Adana detachment) and a maintenance party of 20 personnel. The U-2 arrived independently and very early on May 1 Powers was told he was to fly that day. Before taking off, he was briefed for one and a quarter hours about a flight across the Soviet Union, via the Aral Sea, Sverdlovsk, Kirov, Archangel and Murmansk, to Bodoe. An advance flight plan assumed an average airspeed of 470 m.p.h.

According to the Russians, the equipment included a special wide-angle long-focus Type 73-B camera with a rotary lens, which took photographs through seven hatches, and could photograph a strip of territory 100-125 miles wide. There was enough "highly sensitive" film to take 4,000 pictures along a 2,170-mile route, and that developed from the crashed U-2 covered an area from the north of the Soviet border with Afghanistan to the vicinity of Sverdlovsk. These photographs were estimated to originate from between 65,000 and 68,900 ft., and showed large populated localities, industrial and military objectives, airports, anti-aircraft facilities and depots. The film used was generally superior to that used in American reconnaissance balloons, about which the Russians have previously complained.

Radar-plotting Equipment

Electronic equipment included radar-receiving aerials capable of picking up four different wavebands and, as there were two of each type of antenna, they could be used for locating the origin of the signals. On receiving radar signals from Soviet A.A. installations, these indicated that the aircraft was being so picked up. Analysis of tape-recorded signals recovered from the U-2 showed that they came from Soviet A.A. radar stations, long-range spotting and fighter-direction radars.

Also on board the U-2 were explosive destruction devices to destroy the aircraft and its equipment. These comprised about 3 lb. of powerful hexogen explosive installed near the cockpit, from which it was intended to be operated. With the normal survival equipment for the pilot was a silenced pistol, and 200 rounds of ammunition, ignition flares for camp fires, and a curare-tipped poison pin for use in the event of torture.

In case of early trouble the U-2 would be landed at airfields in Pakistan or Iran; during the later stages of the flight any difficulty, such as shortage of fuel or oxygen, would be met, if possible, by turning at Kandalaksha on a track over northern Finland instead of following the assigned route via Murmansk (Kola Peninsula) to Bodoe. Powers' map, which had "designated" areas marked only with letters, also carried tracks and headings to different airfields in Finland (emergency only), Sweden and Norway. Radio (UHF) silence would be maintained except during departure and arrival.

After take-off from Peshawar the U-2 flew, according to the evidence, straight towards the Soviet frontier over the Hindu Kush and north-east Afghanistan. The initial cruising altitude was about 60,000 ft. and the aircraft was cruise-climbed, as fuel was burned, up to 68,000 ft. which, Powers said in his evidence, was its "maximum." According to the indictment the frontier was crossed at 05.36 hrs. (Moscow time) over a point south-east of Kirovabad, Tajik Republic.

Most of the route was cloud-covered. No trouble was experienced during the flight towards Sverdlovsk apart from some unexplained difficulty with the auto-pilot. Notes were made of times, altitudes, air temperatures and weather conditions; the actual fuel consumption was noted and checked against the estimates. The ground speed was about 380 m.p.h. When it was shot down the U-2 had flown about 1,250 miles from the point where it had crossed the frontier. The indictment said that it was hit at 08.55 hrs. (Moscow time).

The "hollow explosion" and "orange flash" were followed by a sudden pitch-down of the U-2. In the indictment evidence Powers said he thought that the "wings and tail started falling off. Perhaps the plane was not hit directly and . . . it was hit by burst and fragments. . . . I think it happened at about 68,000 ft. . . . At that moment I was pressed to the central [instrument] panel and could not use the catapult [ejector seat]. I opened the canopy [at about 33,000 ft.], unfastened the straps and got out of the plane through the top. The parachute opened automatically." Apparently he had not disconnected all the equipment and had some difficulty. He left the aircraft at an altitude of about 14,000 ft.

These final circumstances appear to be almost the only ones about which the evidence might have been distorted. Without knowing the minds of the Soviet authorities or of Powers himself, it is impossible to be sure of the true facts. It may be that the U-2 had had a flame-out or other trouble and had drifted to lower levels before it was hit. Obviously the Soviet authorities would prefer everyone to believe that a rocket had successfully destroyed the aircraft at 68,000 ft.

There were at least two other curiosities: during the trial Powers was not asked in detail about how or when he got out of the aircraft, or about a second U-2 whose pilot was flying on the same morning. Where did this second U-2 fly—or was it (or its pilot) merely a reserve in case of last-minute technical failure or illness? According to some reports this second U-2 was with Powers' aircraft on the flight.

The story, as told in the evidence, is by no means complete.

Air Transport

B.E.A.'s Best Year

LORD DOUGLAS had already announced the fact, in last month's *BEA Magazine*, that the Corporation's profit for 1959-60 would be better than £2 million, so the detailed results, announced last Tuesday, did not come as a surprise. Nevertheless, the actual profit figure is higher than most people expected—£2,086,078 after payment of interest amounting to £1,153,006 (or about 4.6% of the capital).

More significant, perhaps, were the traffic results which, as can be seen in the summarized tabulation on this page, showed much more than World or European average increases. The revenue ton-miles of all traffic increased by 19% and freight ton-miles increased by 28%. The average World air traffic increase for 1959 was about 12% and the intra-European increase was about 13%.

Another important figure to be seen in the table is that for revenue per load ton-mile. This, at 67.4d., showed a decrease of 3.3% on that for the previous year and indicates the general trend towards a lowering of fares and rates. The amount of inclusive-tour traffic no doubt had its influence on this overall reduction; there was a 46% increase by comparison with 1958-59. The year which the report covers was prior to the piecemeal fare reductions agreed at the IATA Traffic Conferences and it will be interesting to see the effects of these.

Financial		Variation as 1958-59 %
Total revenue	£36,536,613	+ 15.0
Total expenditure	£34,450,535	+ 9.3
Profit before interest	£3,239,084	+ 139.2
Profit	£2,086,078	+ 796.5
Traffic		
C.T.M.s offered	191,992,307	+ 6.0
L.T.M.s sold	130,032,466	+ 18.9
Revenue load factor	67.7%	+ 12.1
Cost per C.T.M.	43.1d.	+ 3.1
Revenue per C.T.M.	45.7d.	+ 8.6
Revenue per L.T.M.	67.4d.	− 3.3
Passengers carried	3,289,606	+ 16.3
Rev. passenger-miles	1,153,784,735	+ 16.7
Available seat-miles	1,662,756,681	+ 5.2
Passenger load factor	69.4%	+ 11.0
Mail (tons)	7,848	+ 2.3
Mail ton-miles	4,001,082	− 1.4
Freight (tons)	36,395	+ 29.9
Freight ton-miles	14,893,914	+ 28.2
Staff and Productivity		
Average number of employees	12,170	+ 5.6
C.T.M. per employee	15,776	+ 0.4
Revenue per employee	£3,002	+ 9.0

Note: All tons are short tons = 2,000 lb.

The average load factors were higher than ever and suggest that too much traffic is being turned away. This point was mentioned by Lord Douglas in the July issue of the *BEA Magazine*. "We have, in fact," he wrote, "planned to operate this summer [1960] at load factors a few points lower than the record levels of last year, which were near the limit of what we can achieve without turning away an unacceptable amount of traffic during peak periods." In 1959-60 the domestic service load factors averaged 76% during the summer period and even in the winter the average was 71%.

In spite of these high average load factors and the vigorous development of traffic on the trunk services (there was a 37% passenger-mile increase on the London-Midlands-Scottish route), the domestic network was still being operated at a considerable loss. The report estimates that there was an overall profit on international operations of £2,800,000 while domestic operations suffered a loss of about £700,000. Domestic cargo ton-miles increased by 52.5%—showing the pressure now being put on this side of the air-freight programme—though the total is only about one-seventh of that for all the Corporation's freight operations.

Overall, the good results for the year were obviously helped by the fact that B.E.A. was operating a fleet of well bedded-down and proven aircraft. The average fleet utilization rose from 1,745 to 1,858 hr. per annum, with all the Viscounts averaging much better than 2,000 hr. and the V.701s leading at 2,561 hr.—which is the highest utilization recorded so far by B.E.A. over its predominantly short-haul network.

Gift-horses for Ghana

THE news that Ghana Airways was to acquire four Ilyushin Il-18 turboprop airliners came as a surprise not only to B.O.A.C. Associated Companies, which has a 40% interest in the airline, but also, it appears, to Ghana Airways itself. The decision to acquire these Russian aeroplanes—at an undisclosed price—was, we understand, taken at short notice by President Nkrumah himself. The announcement was made by the Minister of Transport and Communications, Mr. Krobo Edusei, at a ceremony on Aug. 18 to mark the handing over of Ghana Airways' Britannia 309.

The Ilyushins may prove more of a liability than an asset to Ghana Airways, which had not previously indicated that it was in the market for this type of aircraft. Since its formation in July, 1958, the airline has been making rapid progress towards achieving complete autonomy as a nationally owned company, and some talks have already been held with B.O.A.C. with a view to acquiring the latter's £160,000 share. This is, however, a process which cannot be pressed too quickly, especially if adequately trained Ghanaian staff are to be available.

The Britannia 309 has been purchased to take over the Accra-London service which is flown at present by B.O.A.C. Britannias on charter, and a second may also be bought from Bristol. Earlier this year, three Viscount 810s were ordered, for 1961 delivery, to be used on the Accra-Dakar route and on a proposed service to Beirut. The company also operates two D.H. Herons and two DC-3s locally in West Africa.

The Il-18s—examples of which were seen in Ghana recently to ferry the country's U.N. contingent to the Congo—could presumably be used on the route to London, or more probably to extend the services in Africa and the Middle East. It is now up to Ghana Airways to work out how it can best use these gift-horses, which, it is to be presumed, will be flown by Russian crews. The first two Ghana nationals to qualify as pilots are now under training in England and will graduate eventually to the Herons. No mention has been made of Ghanaian nationals learning to fly Il-18s, but it has been reported that about 40 ground crew and air hostesses will train in Moscow.

ON TEST.—Three Vanguards, including the first (illustrated) and second for T.C.A. are now flying with limited-life Tynes, pending delivery of production engines with new compressors. A 200-hour route-proving period with the modified engines is expected to begin next month.

a Product Bulletin

DOWTY GROUP

The Dowty Group produces Europe's most diverse range of aircraft equipment. Illustrated in this bulletin are aviation products of three member companies—Dowty Rotol Limited, Dowty Fuel Systems Limited and Dowty Nucleonics Limited.

Other member companies produce precision machined components and assemblies for aircraft constructors and engine manufacturers.

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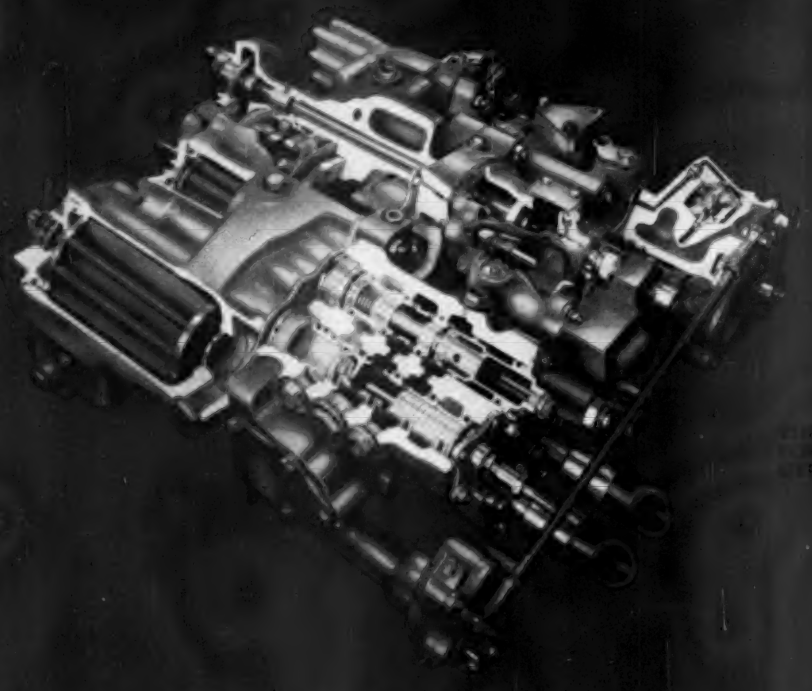
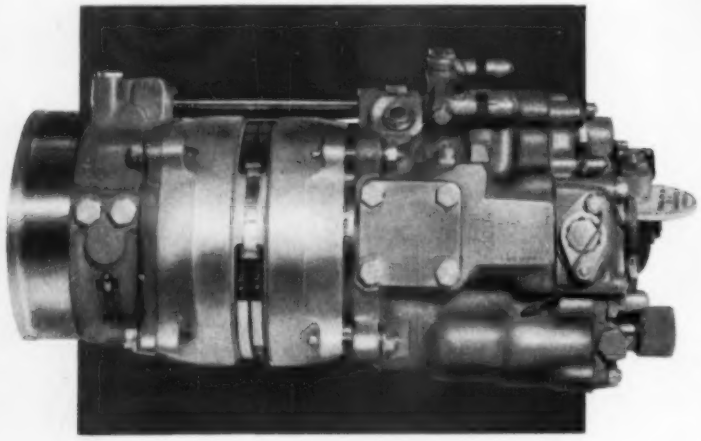


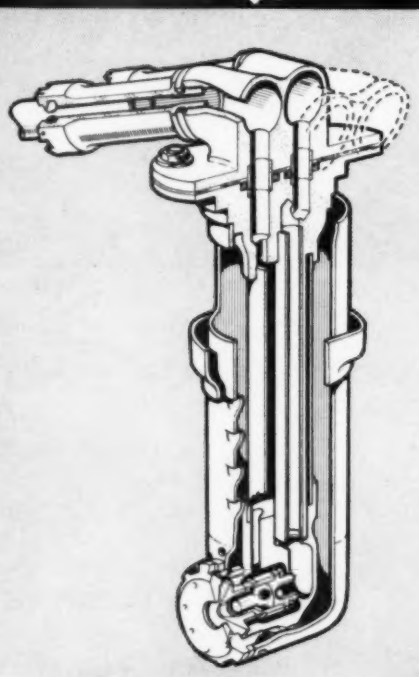
THE DOWTY FUEL SYSTEM FOR THE DE HAVILLAND GYRON JUNIOR

Dowty Fuel Control systems are currently fitted to many high performance jet engines including the de Havilland Gyron Juniors of the Blackburn N.A.39.



FUEL PUMPS
Dowty fuel pumps meet the requirements of gas turbine engines using any type of nozzle, or vaporiser. The range includes plunger, centrifugal and gear-type units.

SPILL NOZZLE
Due to the absence of small restrictions the performance is unaffected by fuel contamination or gumming. The burner maintains a substantial pressure level at high-altitude low-flow conditions and obviates the risk of fuel boiling.



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A new undercarria switch utilising a lev a push button. A with twist override

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ARRIAGE LEVER

undercarriage selector
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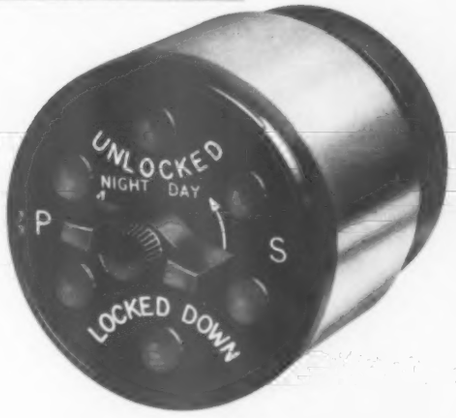
override is provided.

THROTTLE GRIP SWITCH
A new unit which groups existing controls so that three switches can be operated by the pilot without removing his hand from the throttle.



12-LAMP SUB-MINIATURE
UNDERCARRIAGE INDICATOR
More compact version of the proven 9-lamp indicator. All six lamps are duplicated for reliability and easy checking. Dimming facility incorporated. No manual selection required.

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THE DOWTY FUEL SYSTEM FOR THE HAVILLAND [illegible]

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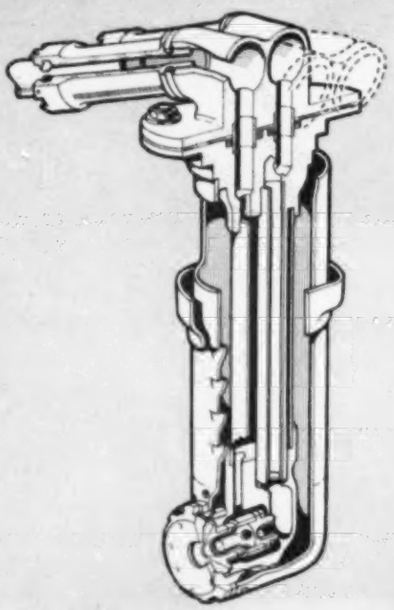
Due to the absence of small restrictions the performance is unaffected by fuel contamination or gumming. The burner maintains a substantial pressure level at high-altitude low-flow conditions and obviates the risk of fuel boiling.



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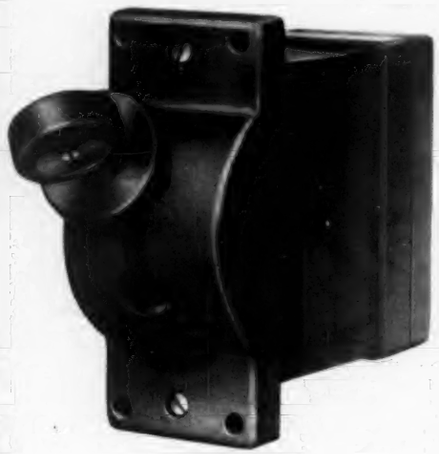

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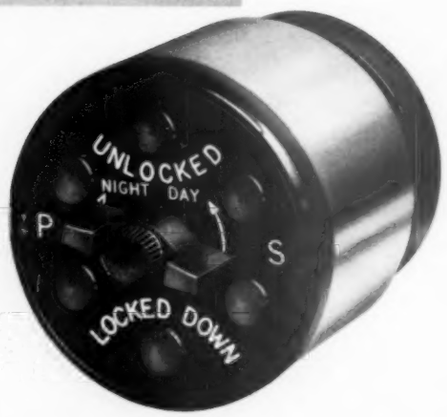

12-LAMP SUB-MINIATURE UNDERCARRIAGE INDICATOR
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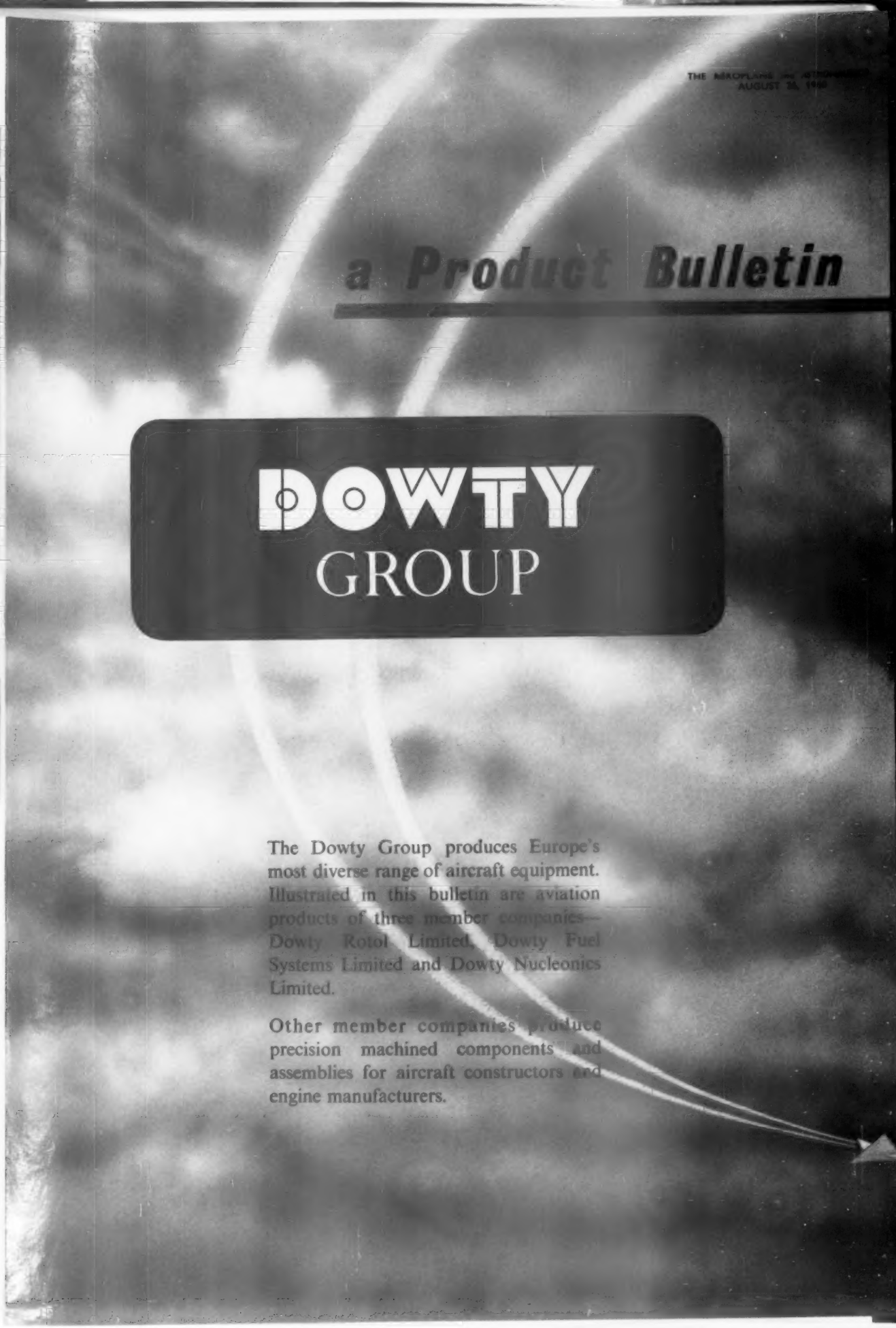
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DOWTY ROTOL UNDERCARRIAGES
Dowty Rotol undercarriages have outstanding operational records on civil and military aircraft of all types.

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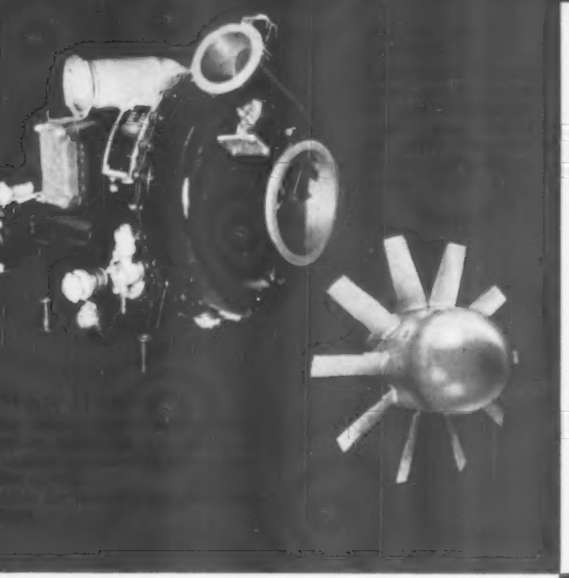
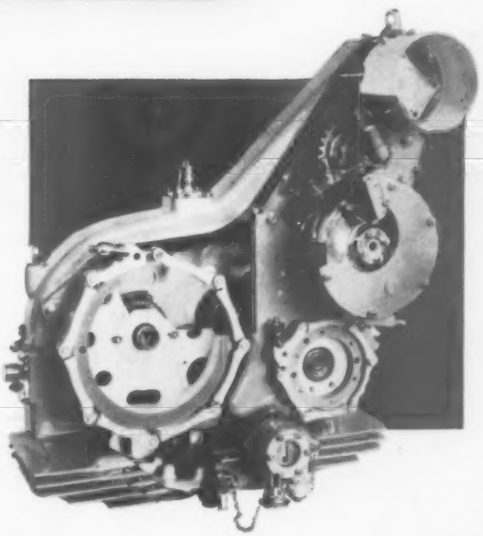
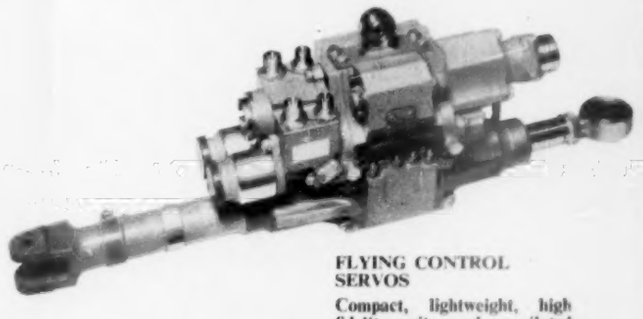


VICKERS VISCOUNT PROPELLERS

Dowty Rotol Propellers on the Viscount have achieved over 8 million flying hours. They have similar records on many other aircraft.



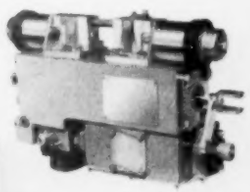


FLYING CONTROL SERVOS

Compact, lightweight, high fidelity units used on piloted aircraft and guided weapons.

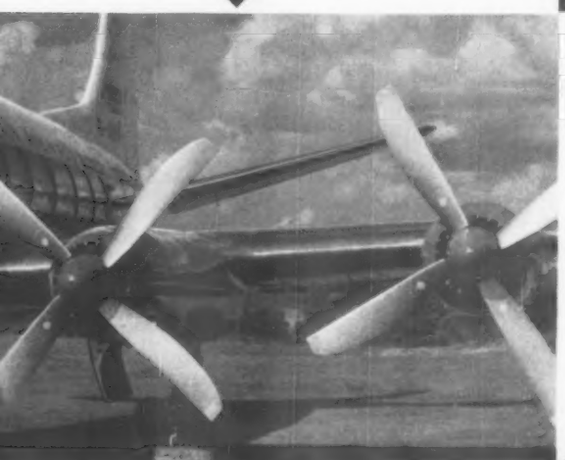
Above: Tandem hydraulic actuator with manual and electrical signals.

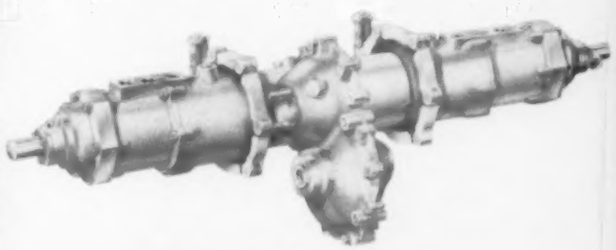
Left: Electrically signalled hydraulic actuator for auto-stabilisation.



DOWTY MOOG ELECTRO-HYDRAULIC SERVO VALVE

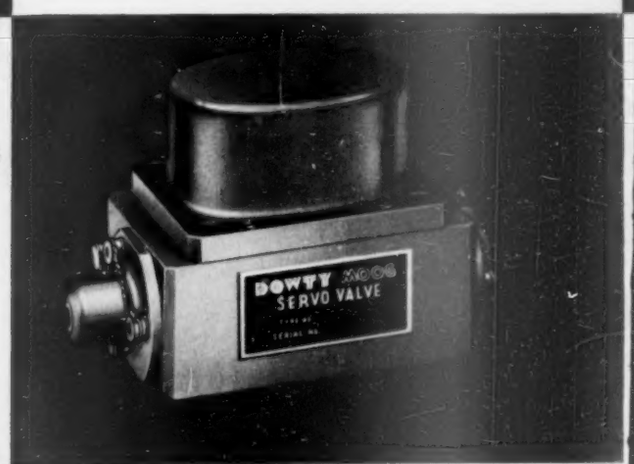
One of a range of high fidelity miniature servo valves.





DIFFERENTIAL FLAP GEARBOX

This unit is fitted with normal and emergency hydraulic motors.



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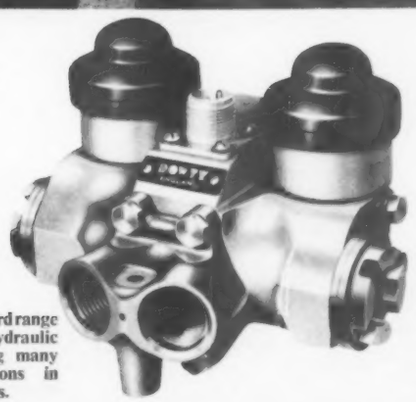

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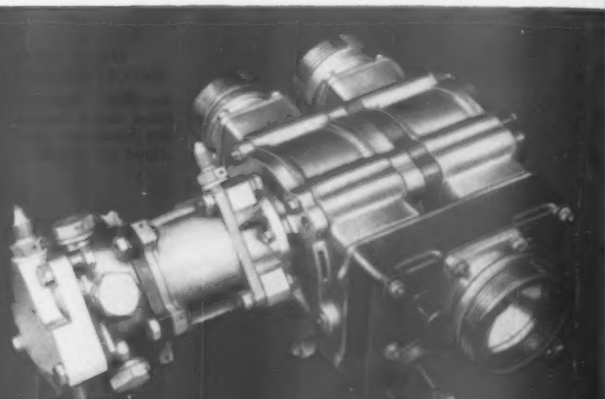

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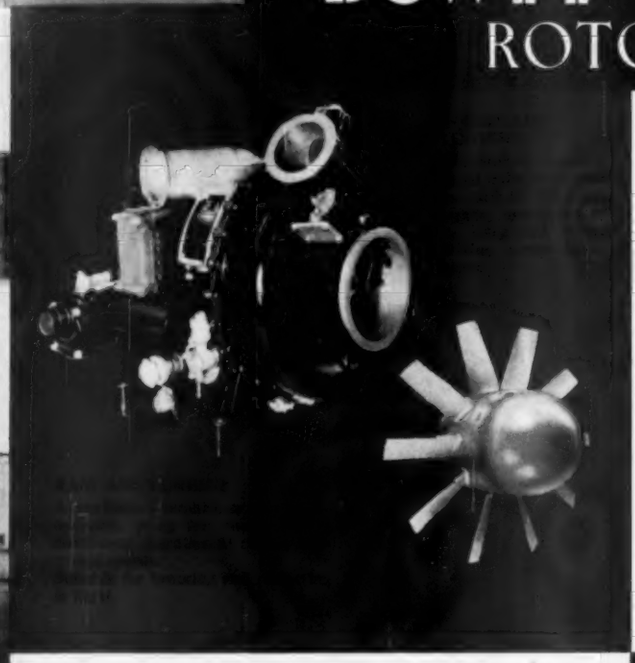
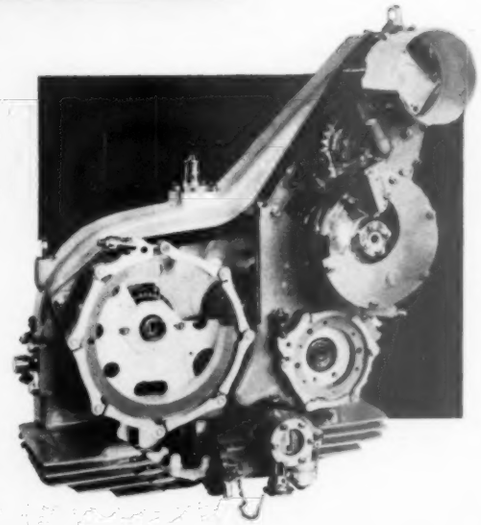
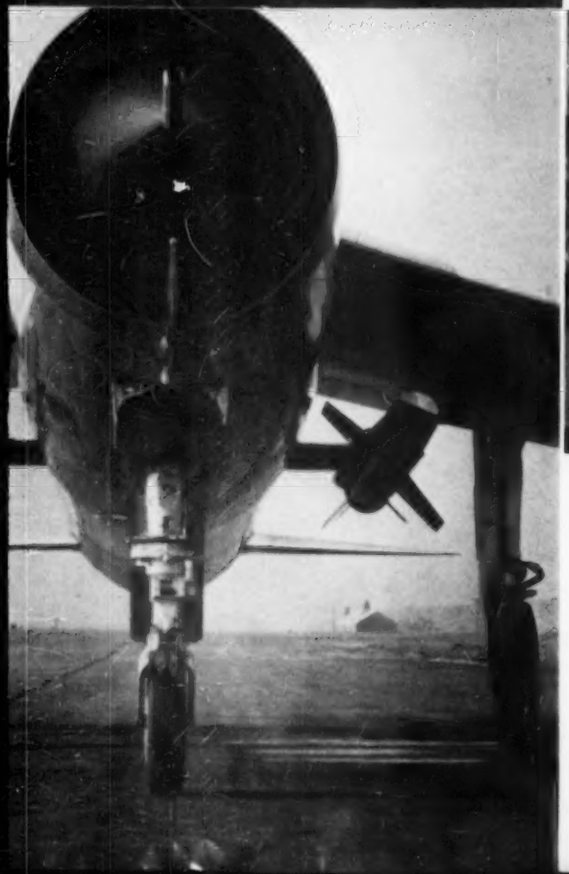
DOWTY ROTOL LIMITED

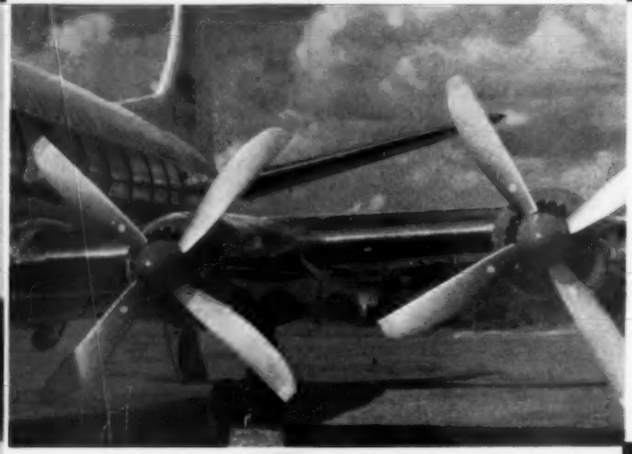


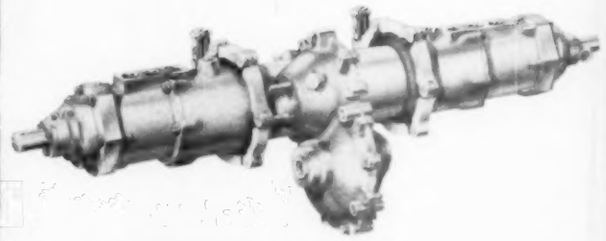


VICKERS VISCOUNT PROPELLERS

Dowty Rotol Propellers on the Viscount have achieved over 8 million flying hours. They have similar records on many other aircraft.



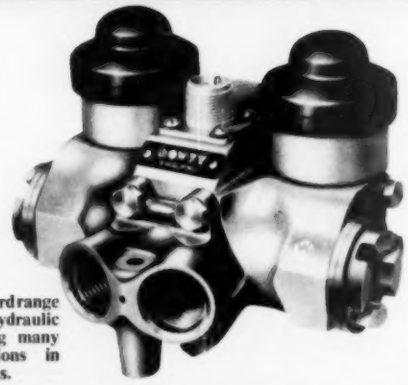




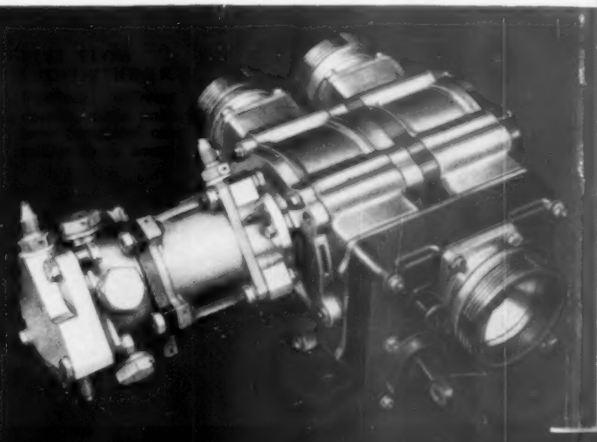
DIFFERENTIAL FLAP GEARBOX

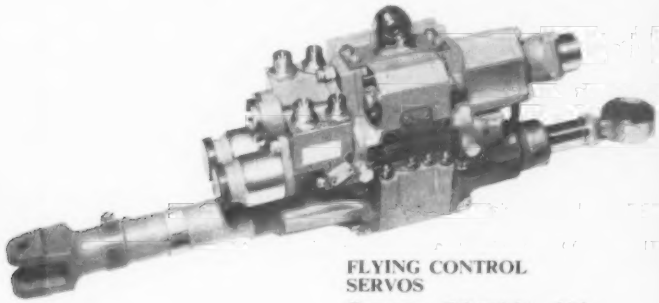
This unit is fitted with normal and emergency hydraulic motors.

HYDEL SELECTOR VALVES



One of a standard range of electro - hydraulic valves covering many control functions in aircraft systems.



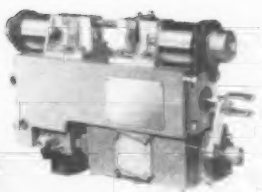


FLYING CONTROL SERVOS

Compact, lightweight, high fidelity units used on piloted aircraft and guided weapons.

Above: **Tandem hydraulic actuator with manual and electrical signals.**

Left: **Electrically signalled hydraulic actuator for auto-stabilisation.**



DOWTY MOOG ELECTRO-HYDRAULIC SERVO VALVE

One of a range of high fidelity miniature servo valves.

HYDRAULIC ACCUMULATOR
A typical accumulator for a missile system.

HYDRAULIC JACK
This custom built jack with swivel couplings is typical of the many used in aircraft systems.

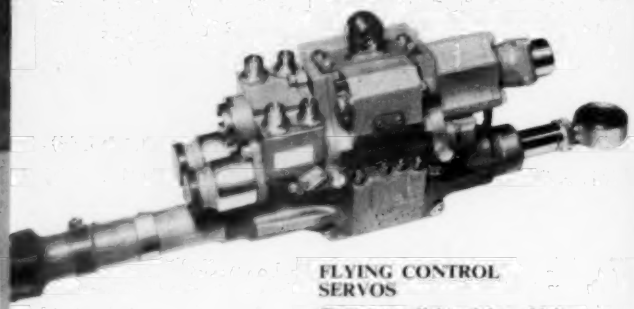
Write for full technical information on all these products

DOWTY GROUP LIMITED · CHELTENHAM · ENGLAND

DOWTY ROTOL LIMITED · CHELTENHAM ROAD · GLOUCESTER
Telephone: **Gloucester 24431**

DOWTY FUEL SYSTEMS LIMITED · ARLE COURT · CHELTENHAM
Telephone: **Cheltenham 53471**

DOWTY NUCLEONICS LIMITED · TEWKESBURY · GLOS.
Telephone: **Tewkesbury 2083**



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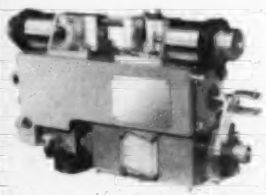

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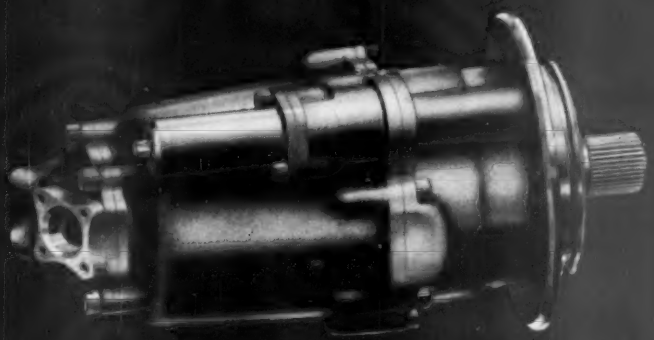

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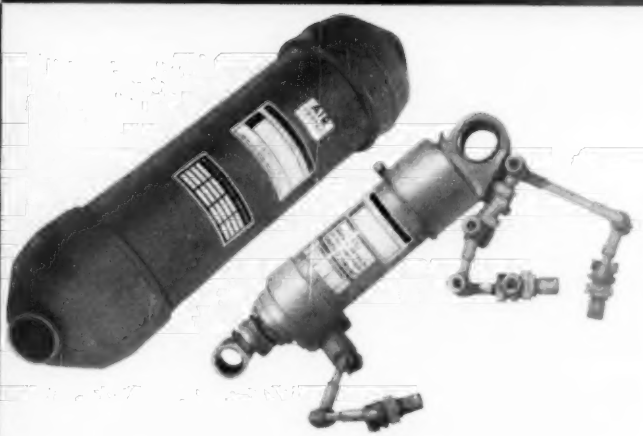

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RED EXPORT.—In addition to Aeroflot, seven airlines are now reported to be using or planning to use the turboprop Il-18. They are C.S.A. (whose first Il-18 is illustrated), the East German D.L.H., L.O.T., Malev, Tabso, the Chinese C.A.A.C. and Ghana Airways, whose order for four is reported on another page.

Air Transport . . . .

Cunard-Eagle

FOLLOWING the acquisition last March of a majority shareholding in Eagle Airways by the Cunard Steamship Co., Ltd., the name of the company has been changed to Cunard-Eagle Airways, Ltd. It is anticipated that the Cunard prefix will be applied to other companies in the Eagle Group in due course; these companies include Eagle Airways (Bahamas) and Eagle Airways (Bermuda). The name of Harold Bamberg (Holdings), Ltd., the company which shares with Cunard an interest in the Eagle Group, was changed to British Eagle International Airways, Ltd., last February, but we understand a further change to Cunard-Eagle Airways (Holdings), Ltd., is now planned.

These changes of name suggest that Cunard has no intention of hiding its participation in air transport, in contrast to most of the shipping interests which are already associated with other operators. Hitherto, the only shipping names which have actually appeared on aircraft are those of Hunting-Clan and its associated British and Commonwealth Shipping; both these companies are now merged into British United Airways and their individual liveries are in process of disappearing.

Good Qantas Year

IN contrast to the indifferent financial results suffered by some airlines during their first year of turbojet operations, Qantas did much more than hold its own in 1959 with a net profit of £A853,963 after payment of tax. This was more than double the profit for 1958.

In fact, when announcing the profit, the Australian Minister for Civil Aviation, Senator Paltridge, described the good result as being a direct result of Qantas' decision to buy Boeing 707-138s and thus to have a competitive advantage, especially over the Pacific.

The profit represents 3½% on turnover and about 7% on the average capital—figures which are good for an airline, but still marginal by normal commercial standards. The 1959 revenue was £A29,257,563 (£A23,871,102 in 1958). The capacity ton-miles offered totalled 147,576,942 (129,892,348) and the total revenue ton-miles were 81,958,841 (73,310,308), giving an average overall load factor of 56.2% (56.4%).

The Air-freight Business

ONE of the more significant series of comments in B.E.A.'s report for 1959-60 (see p. 240) referred to freight development. Whether or not the Corporation yet needs a small fleet of specialized all-cargo aircraft, the point was made that such aircraft would be very useful in developing techniques for handling and loading in preparation for the expansion which will undoubtedly come.

This is a point which is not often stressed. Although it is obvious that the so-called break-through in air cargo will be the result of steady progress on all fronts, it may be that the eventual rush of business will find the airlines unprepared in the organization at the terminal and on the apron. B.E.A. is at present undecided about the timing of the purchase of really specialized aircraft, but will certainly increase its all-freight capacity one way or another—possibly by converting Viscount 800s, which would remain usable as necessary for passenger-carrying.

The Corporation's next-generation aircraft should have adequate fill-up capacity to deal with more immediate freight-traffic increases. Even with a 70% passenger load factor the Vanguard has a payload reserve of 4½ tons for its underfloor holds and even the D.H.121 will be able to take about 2½ tons. In five years' time B.E.A. will have a total available cargo capacity equivalent to about 100 million ton-miles on its passenger services. The 1959-60 recorded freight ton-miles for all services was a little less than 15 million, so, even if the traffic increase averages 30% per annum, theoretical capacity should be available until 1967.

The progress which has still to be made in the air-freight business is indicated by the fact that revenue, even from B.E.A.'s extensive cargo operations, amounts to no more than 7.2% of the Corporation's total income—and this is probably as high a percentage as is being recorded by any essentially passenger-carrying airline.

Convair's Short-haul Project

NOW competing for the U.S. domestic airline market for a short-haul jet transport is the Convair Model 60. Designed for operations on ranges up to 1,600 naut. miles carrying up to 85 passengers, the Model 60 has the same wing as the Convair 880M, but only two engines and a shorter fuselage. It falls into the general category of a Viscount/Convairliner replacement, being of smaller capacity than such types as the Sud-Douglas Caravelle, D.H.121 and proposed Boeing 727, but rather larger than the Hunting 107 and Avro 771 projects. Selling price would be about $3.5 million—more than twice the cost of the two last-named British short-haul proposals.

The fuselage, 109 ft. 5 in. long, accommodates 17 seat rows at 38-inch pitch, providing 68 seats four abreast or 85 five abreast. Two underfloor cargo holds have capacities of 208 cu. ft. and 255 cu. ft., and there are also two carry-on baggage compartments, of 60 and 70 cu. ft. capacity respectively.

The engines can be either 20,000 lb. Pratt & Whitney JT3D-10 or 22,000 lb. General Electric CJ805-41C1 turbofans in pods on the 120-ft.-span wing. This wing, having the same 2,000 sq. ft. area as the Model 880, has double slotted flaps and leading-edge slats. The fuel capacity is reduced to 44,000 lb. in integral tanks.

SPECIFICATION.—In the 68-seat version, the operational weight empty is 80,600 lb. and the space-limited payload, 16,670 lb.; weights for the 85-seater are respectively 80,860 lb. and 19,565 lb. Max. take-off weight is 145,500 lb., max. zero fuel weight, 102,000 lb. and max. landing weight, 140,000 lb. At 110,000 lb. the Convair 60 cruises on max. cruise thrust at 509 knots at 19,500 ft. and 485 knots at 35,000 ft. Take-off distance for a 1,200 naut. mile sector with 68 passengers is 5,130 ft. in I.S.A. and 5,970 ft. at 90° F., both at sea level. The landing runway length required at max. landing weight is 5,060 ft. at sea level in I.S.A.

Air Transport . . . .

Rationalizing Fuel Reserves

SOME years ago the Institute of Navigation set up a working party to study the philosophies underlying current practices of fuel reserve calculations, to look at parameters common to all systems and to assess their application to future operations. The working party was drawn from a representative selection of members with appropriate experience and its report appeared in the July, 1960, issue of *The Journal of the Institute of Navigation*.

An essential preliminary was to obtain a representative cross-section of present airline fuel-reserve practices and the methods and views of more than a score of operators were examined. This work, however, served only to show the varied and arbitrary nature of the methods in current use. It was apparent that there were at least two widely differing approaches to the problem. One, which might be described as orthodox, involved the assumption that the destination airport was closed; in the other the situation was continually being assessed as the flight progressed.

The conclusions reached by the working party were to the effect that current airline practices revealed a lack of sophistication in the methods used and that the adoption of operating techniques which would break away from the orthodox "fuel to destination, plus fuel to alternate, plus holding" would probably enable the airlines to carry greater payloads. The development and acceptance of such new methods would be greatly helped by an improvement in the accuracy of weather forecasts and by a study of the values of the operating variables.

Although a statistical approach was considered to be feasible (and may be the only practical one), no studies on these lines have been wide enough in scope or sufficiently detailed in nature to permit any universally applicable values to be stated.

The working party recommended that "the existence of this problem should be drawn to the attention of an organization equipped with facilities for electronic data processing and that arrangements be made for the undertaking of a project which would endeavour to establish statistical values for the parameters outlined [by the working party] and to present these in a form which could be used in the everyday practice of air navigation."

Rear-engined Arithmetic

DEVELOPMENTS of the Super VC10 soon to be announced by Vickers range in gross weight up to 373,000 lb. and have wing loadings exceeding 133 lb./sq. ft. at take-off. These appear to be formidable figures, exceeding by 62,000 lb. and 22 lb./sq. ft. respectively the highest values for jet transports in service today.* That it is possible to contemplate them at all is indicative of the good lift co-efficients of the VC10 wing—which are in turn attributable, at least in large measure, to the rear-engined layout.

Some interesting arithmetic is possible with the most recent available data for the various rear-engined transports. In the tabulation below, for instance, we have indicated the C_L max. for all rear-engined transports; as yardsticks, two older transports—one with buried engines and the other with pods—have also been included in this table. These values for lift co-efficients are derived from the wing loadings at maximum landing weight and V_{SO} speed calculated from published approach speeds. This, we believe, gives a reasonably fair basis for comparison.

AIRCRAFT	Wing loading Max. t.o. wt.	Power loading Max. t.o. wt.	Field length required I.S.A. s.l.	Wing loading Max. landing wt.	App. spd. (1.3 V50) Max. ldg. wt.	Max. CL Landing configuration
	lb./sq. ft.	lb./lb. s.t.	ft.	lb./sq. ft.	Knots	
Comet 4	76.4	3.86	6,750	56.6	124	1.83
Boeing 707-420	107.0	4.43	10,700	71.7	138	1.88
Sabreliner ..	51.8	2.96	5,000	38.0	112	1.51
BAC-107 ..	58.8	3.30	4,700	55.7	110	2.30
Caravelle I ..	60.7	4.56	5,900	57.8	114	2.22
JetStar ..	71.7	3.24	7,000	51.7	130	1.52
Caravelle VIII ..	72.5	3.70	6,450	69.1	124	2.22
Trident ..	77.8	3.46	6,000	74.1	134	2.06
VC11	106.3	3.86	—	—	—	—
VC10	106.9	3.70	7,400	70.5	123	2.32
Super VC10 ..	123.9	3.90	10,400	86.0	135	2.32
Super VC10 dev.	133.2	—	10,300	100.1	147	2.32

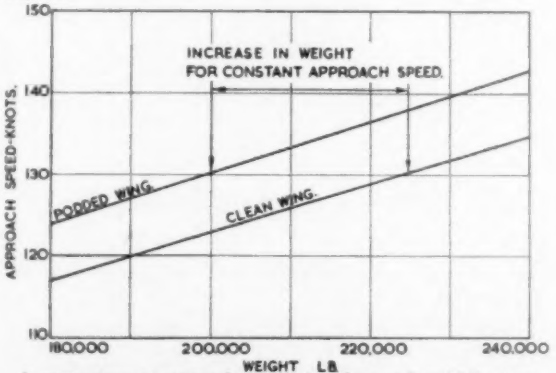
All aircraft in this table except the Sabreliner and JetStar have British engines. The BAC-107, Caravelle VIII, VC11 and Super VC10 development are in the project stage; others are built or building.

It will be seen that the Super VC10 is better in this respect by some 20% than a podded transport, which is in line with the claims made for the rear-engined layout by Vickers a year or so ago (see our issues for Sept. 18 and Nov. 20, 1959). Almost all this improvement is obtained by making maximum use of the wing for leading and trailing edge high-lift devices; about 20% more of the span can be used in this way than is possible with a podded-engine design.

One of the interesting facts which emerges from this table is that the heaviest version of the Super VC10 requires a minimum effective field length for take-off of an acceptable 10,300 ft., compared with which the first-generation turbojets in service today, at much lower weights, require 10,600-10,700 ft.

The way in which the Super VC10 is developing also shows how advantage can be taken in different ways of the fundamentally good airfield characteristics (take-off and landing distances and approach speeds) of the rear-engined layout. In the original VC10, wing loading and power loading are held down to obtain the best possible field performance; in the Super VC10, the field length has been permitted to rise to obtain the best possible payload-range performance. The VC11 has been designed for economic medium-range performance (500-2,000 miles) without compromise, but has the added advantage of blown flaps to help field performance.

Blown flaps, as an example of B.L.C., can easily be adopted on a rear-engined layout where the engines are closely grouped. They can be used—as on the VC11—to retain good take-off and landing properties with the small wing which can be obtained on a rear-engined aeroplane without compromising the approach speed. This, in turn, leads to a more efficient cruising performance. On the graph below it will be seen that the clean wing gives a 25,000-lb. advantage in landing weight for a constant approach speed. This more than compensates for the higher empty weight associated with fuselage-mounted engines.



A comparison of approach speeds for clean and podded wings of constant wing area.

* Greatest take-off weight on record is 488,000 lb. by a Boeing B-52. The wing loading was well over 200 lb./sq. ft. at this weight; the take-off distance was not reported.

44

AIRLINES HAVE CHOSEN . . . VISCOUNT

All Nippon Airways of Tokyo — three Viscount 810's ordered! Ghana Airways—three also! This now makes forty-four airlines with Viscounts in service or on order, as listed opposite. Five Governments and seven private companies or individuals also operate Viscounts.

22

HAVE RE-ORDERED . . . VISCOUNT

Of these forty-four airlines, twenty-two have now placed repeat orders for Viscounts.

2,500,000

HOURS HAVE BEEN FLOWN BY . . . VISCOUNT

This impressive total includes half a million revenue hours flown by BEA up to April 1960.

EUROPE
British European Airways
Air France
Aer Lingus
K.L.M.
Lufthansa
Alitalia
Austrian Airlines
Turkish Airlines
Airwork
Hunting Clan Air Transport
Tradair
Transair
Eagle Aviation
Icelandair

NORTH AMERICA
Capital Airlines
Continental Airlines
Northeast Airlines
Trans-Canada Air Lines
Maritime Central Airways

CENTRAL AND SOUTH AMERICA AND CARIBBEAN
Vasp (Brazil)
Pluna (Uruguay)
L.A.V. (Venezuela)

VISCOUNT

FOUR ROLLS-ROYCE DART TURBO-PROP ENGINES

Lloyd Aereo Colombiano
TACA (El Salvador)
British West Indian Airways
Cubana

MIDDLE EAST
Middle East Airlines
Misrair (Egypt)
Iraqi Airways
Iranian Airways
Kuwait Airways

AFRICA
Central African Airways
Sudan Airways
South African Airways
Ghana Airways

SOUTH EAST ASIA
Indian Airlines Corporation
Pakistan International Air Lines
Union of Burma Airways
Malayan Airways

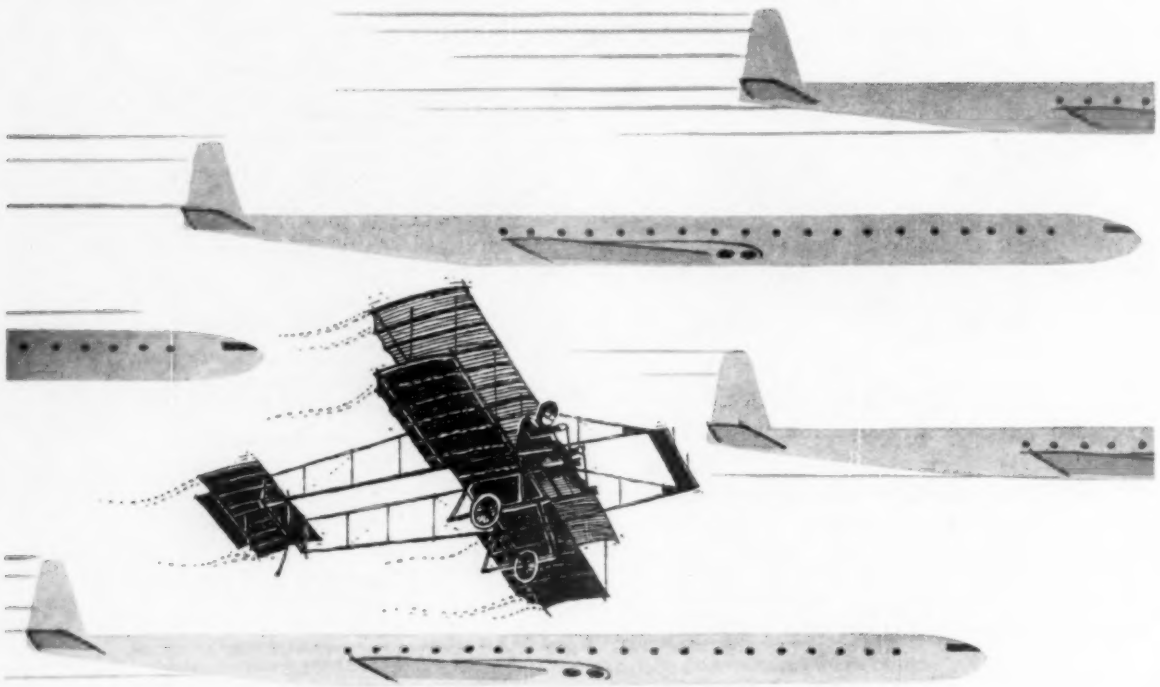
AUSTRALASIA
Trans-Australia Airlines
Ansett-A.N.A.
New Zealand National Airlines Corporation

PACIFIC
Philippine Air Lines
All Nippon Airways

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

MEMBER COMPANY OF BRITISH AIRCRAFT CORPORATION

TGA A76 60



de Havillandmark!

The plane in which Sir Geoffrey flew
(Plain Geoffrey he was then)
Looked, one supposes, rather new
Way back in 1910.
But things have speeded up a bit
Since that far distant day,
And now it looks, one must admit,
A trifle—well, *demodé*.
A revolution in the sky
These few short years have spanned,
Which is of course the reason why
We toast DE HAVILLAND.
The Comet (also pictured here)
Is ample proof today
Of how our heroes year by year
Still pioneer the way.
Mosquitoes, Moths, and Firestreaks—
So many famous names!
How gloriously their record speaks
The fame the world acclaims!
These noble deeds, in peace and war,
We can't spend too much time with.
We haven't got the space (what's more
They're rather hard to rhyme with).
To put it briefly (as we ought;
For other pens than this
Have space to give the full report
And time to reminisce),
DE HAVILLAND, may your success
And your prosperity
Through four times forty ne'er grow less—

Yours truly,

AIR BP

The Fighting Services

A.D.C.s to Her Majesty

ADMIRAL SIR CASPAR JOHN, G.C.B., has become Principal Naval Aide-de-Camp to H.M. The Queen in succession to Admiral Sir William Davis, G.C.B., D.S.O.

Appointed First Sea Lord and Chief of Naval Staff in May of this year, Sir Caspar has had a long association with Naval aviation. In January, 1951, he took over command of the Third Carrier Squadron and the following year became Chief of Naval Air Equipment and Chief Naval Representative at the Ministry of Supply. He was promoted to Vice-Admiral in March, 1954, and took up the appointment of Flag Officer Air (Home) in June, 1955. In January, 1957, he became Vice-Chief of Naval Staff.

Group Captain D. B. Hatfield, C.B.E., an Assistant Director in the Ballistic Missile Division of the Ministry of Aviation, has also been appointed an Aide-de-Camp to Her Majesty. An armaments specialist, he completed the staff course at the Empire Air Armaments School at Manby in 1946, and in 1949 commanded the school after taking the 1948 course at the R.A.F. Staff College, Andover.

Trenchard Memorial Awards

THE Air Council has instituted a number of annual cash grants, to be known as Trenchard Memorial Awards, for individuals or small groups of R.A.F. personnel engaging in projects of a sporting or adventurous nature. Under the scheme, which is open to all members of the Service including the W.R.A.F. and the P.M.R.A.F.N.S., these grants will be made to help defray the expense of unconventional projects.

Intended to act as an incentive to personnel to plan and execute worth-while undertakings on their own initiative, these awards will be granted by an Air Ministry committee headed by the Air Member for Personnel. This committee will meet each January and July to consider applications and make the awards from a £2,500-a-year grant provided by the R.A.F. Central Fund. It will meet for the first time next January.

Applicants for awards must describe their proposed activity, indicate who will take part in it, estimate its total cost and calculate how much money is required from the fund. Projects should normally be undertaken during leave, but activities requiring special leave without pay will be considered.

Fighter Command

AIR COMMODORE C. J. MOUNT, C.B.E., D.S.O., D.F.C., has become Senior Air Staff Officer at No. 13 Group, Fighter Command.

Appointed C.O. of R.A.F. Waterbeach in 1950, he later became Senior Air Staff Officer at No. 81 (Fighter) Group. Following planning and operations duties at Headquarters 2nd T.A.F., Air Cdre. Mount took the 1957 course at the Imperial Defence College. Since 1958 he has been successively Director of Air Plans and Director of Air Staff (Briefing) at the Air Ministry.

Old Originals' Dinner

THOSE wishing to attend the "Old Originals'" Royal Flying Corps Reunion Dinner—for officers who were serving in the R.F.C. in August, 1914, or earlier—at the Royal Air Force Club, Piccadilly, on Oct. 6, at 7 p.m., should inform the Hon. Secretary, R.F.C. Dinner, The Little Belfry, Uckfield, Sussex. The cost of the dinner is £2 a head.

The Royal Air Force Club has, very kindly, offered to provide rooms for non-members who wish to stay the night. Applications should be made to the Secretary, R.A.F. Club. Marshal of the R.A.F. Sir John Salmond and Air Chief Marshal Sir Philip Joubert have expressed their intention to attend.

Southern Cameroons Detachment

EARLY next month a detachment from No. 230 Squadron (Sqn. Ldr. H. J. West, D.S.O., D.F.C.) is due to leave the United Kingdom for a nine-month stay in the British Cameroons. There the Squadron is to provide air support for the British Army units which are to relieve Nigerian troops in the Cameroons in advance of the declaration of Nigerian Independence on Oct. 1.

Australian Army Bells

THE recently announced Australian Army helicopter wing is to be equipped with 11 Bell 47G-2 Troopers, the commercial version of the U.S. Army's H-13H Sioux. To be employed on reconnaissance and liaison duties in the field, the 47G-2s will be flown by Army pilots, the first of whom are at present undergoing helicopter conversion training with the R.A.N. at Nowra Naval Air Station.

To be shipped to Australia later this year, the 47G-2s will be based at R.A.A.F. Amberley, Brisbane. They are to be operated by the Australian Army for an initial trial period of three years.

NEW UNDERCARRIAGE.—The outcome of a recent Westland investigation for the Army Air Corps has resulted in the development of this skid undercarriage for the Mk. 12 Skeeter. It is fitted with rebound dampers in order to prevent large loads being imposed on the helicopter's airframe.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Gp. Capt. A. F. Ward, O.B.E., and Gp. Capt. C. B. Brown, A.F.C., to the Department of the Chief of the Air Staff; Wg. Cdr. G. H. Tebboth to the Department of the Air Member for Supply and Organization.

Fighter Command: Wg. Cdr. J. W. Louw, O.B.E., D.F.C., to Headquarters as Group Captain, Organization, with acting rank of Gp. Capt.; Wg. Cdr. C. F. Atkinson to Headquarters for organization duties.

Coastal Command: Wg. Cdr. R. T. Billett to Headquarters for operational requirements duties; Sqn. Ldr. M. F. J. Mathews, A.F.C., to Headquarters, No. 18 Group, as Wg. Cdr., Training, with acting rank of Wg. Cdr.

Transport Command: Wg. Cdr. J. Macdonald, M.A., to Headquarters as Command Education Officer.

Flying Training Command: Wg. Cdr. G. T. Dale to R.A.F. Valley as Senior Technical Officer.

Maintenance Command: Wg. Cdr. W. Stapleton to R.A.F. Andover to command; Sqn. Ldr. G. E. F. Johnson to Headquarters for work study duties, with acting rank of Wg. Cdr.

Signals Command: Wg. Cdr. B. R. Siminson to the Radio Engineering Unit, Henlow, as Senior Equipment Officer.

Other Appointments: Wg. Cdr. J. M. S. Adams and Wg. Cdr. A. Brown, D.F.C., to the United States Air War College on exchange posting; Wg. Cdr. B. Brooke to Allied Forces, Mediterranean, for communications duties; Wg. Cdr. R. I. Gray to the United States Naval Weapons Laboratory on exchange posting; Wg. Cdr. L. Kendrick, O.B.E., to R.A.F. Safi, Malta, to command the maintenance base.

Reunions

No. 11 Squadron.—All ranks reunion dinner will be held at the Albert Tavern, Victoria Street, London, S.W.1, on Oct. 8. Tickets can be obtained from W. L. Wheeler, 39 Stretten Avenue, Cambridge.

No. 68 Squadron Reunion.—The 16th annual reunion of No. 68 Squadron will be held in the Parke Suite of the Dorchester Hotel, London, on Oct. 15. Tickets, price £3 each, may be obtained from Sqn. Ldr. P. Smith, M.B.E., at 4 Queen Elizabeth Road, Camberley, Surrey.

No. 115 Squadron.—The annual reunion dinner open to all past and present members of No. 115 Squadron will be held at Ye Olde Cock Tavern, Fleet Street, London, E.C.4, on Saturday, Sept. 24. Tickets, price 15s. 6d. each, may be obtained from P. Williams, 111 Burton Road, London, S.W.9.

No. 208 Squadron Reunion.—The No. 208 Squadron Old Comrades Association reunion will be held at the Swiss Hotel, Old Compton Street, London, W.1, on Oct. 22. Buffet tickets, price 7s. 6d. each, are obtainable from R. W. Booker, 18 Blacksmiths Crescent, Sompting, Sussex.

Forty Years On

The Story of de Havilland Aeroplanes and the de Havilland Aircraft Company

Sir Geoffrey de Havilland, C.B.E., A.F.C., Hon. F.R.Ae.S., built and flew his first aeroplane in 1910.

ON September 25, 1920, the de Havilland Aircraft Company, Ltd., came into existence. Just about forty years later, the chairman of de Havilland Holdings, Ltd., Sir Aubrey Burke, O.B.E., observed in his statement accompanying the Report and Accounts for the year ended Sept. 30, 1959, that in the life of the company the industry of aeronautics had developed from the construction of simple wooden aircraft to that of the space vehicle. By word and picture in the story which follows we shall show how the remarkable tale of achievement began with the ardent vision of a young man and grew steadily through his continuing belief and the enthusiasm of the team which grew up around him. Of this team a significant number are not only still alive but still connected with the great business which in the course of this year has joined itself to the Hawker Siddeley Group of which Sir Aubrey Burke is deputy chairman.

As we have said it all began with the ardent faith of a young man. The name of Geoffrey de Havilland as designer and pilot has probably had a longer period of distinction than that of any other pioneer of British aviation. He flew his first aeroplane, designed and built by himself, in 1910. He piloted himself on his last solo flight in a Leopard Moth on Aug. 14, 1952. He still takes a keen personal interest in the work of the D.H. design team.

It was not forty years ago, but fifty-two that the great story began. In 1908 the young Geoffrey de Havilland, obtaining £1,000 from his grandfather, threw up a good post in the growing motor-car business and set to work to design the light-weight petrol engine which was his first requirement. Another young engineer, Frank Hearle, agreed to help him. This effort was backed with some experience, for at his last term at the Crystal Palace School of Engineering, where the famous C. G. Grey had also been a student, the youthful de Havilland had designed and built a successful single-cylinder four-stroke engine which he put into a motorcycle to carry him between the Crystal Palace and his home at Newbury.

The fascinating thing about the first de Havilland aero-engine was its layout which anticipated that to be fashionable many years later. This first engine had four water-cooled cast iron cylinders of 4½ in. bore and 4½ in. stroke. These were mounted in pairs horizontally opposed on an aluminium crankcase. It weighed 250 lb. and as it was 40 to 45 b.h.p. at 1,500 r.p.m. it weighed some 5½ lb. per h.p. This engine was put out to the Iris Motor Co. at Willesden.

CONFERENCE.—Sir Geoffrey de Havilland, Major Frank Halford and Geoffrey de Havilland, Jnr., talking after a test flight.

D.H. and Hearle then set to work on the first de Havilland aeroplane, a twin-screw pusher biplane of 36 ft. span. It had a bevel-gear drive and (note the forward vision) the aluminium-bladed airscrews had adjustable pitch. The pre-doped cotton fabric covering was stitched on a hand-turned Singer sewing machine by the young Mrs. de Havilland. Assembled in a shed on the North Hampshire Downs near Seven Barrows between Litchfield and Highclere, the aircraft crashed on its first flight one day in December, 1909, when the port wings failed in the air. Other pioneers encountered structural failure, not infrequently disastrously, but survival from this accident was the first step in learning the hard way. The inadequate spars of American whitewood were replaced by spars of silver spruce and the complicated twin airscrew layout replaced by a single pusher airscrew. On a calm Saturday evening in September, 1910, the first de Havilland aeroplane to fly became airborne. Its designer and constructor then set about teaching himself to fly.

In a strange way the State intervened. Most of grandfather de Havilland's £1,000 had gone. Prospects looked gloomy. Then through two men who were also to play notable parts in British aviation, the young de Havilland was offered a government job at Farnborough and not only was he offered a job as a designer and as a pilot but the Army Balloon Factory, as it was then, bought the D.H.2 for £400. Frank Hearle was taken on as mechanic.

But State aid for aviation in those days was extremely modest. The D.H.2 became the Farnborough Experimental No. 1 through a series of "repairs"—money was not available for building new aeroplanes. By much involved "modification", the canard-type elevator was abandoned, a hinged elevator was attached to the tailplane and the de Havilland power plant replaced by a 50 h.p. Gnöme.

After working on a new pusher biplane for the Army, D.H. got out a tractor biplane, the Blèriot Experimental No. 1, which became the forerunner of the famous B.E.2 series. Then another man whose personality towers high in British aeronautical history appeared on the scene.

Mr. Holt Thomas whose Aircraft Manufacturing Company was assembling French Maurice Farmans with Renault engines decided to design and build his own machines. To this end he engaged de Havilland as chief designer, at £500 per annum be it noted, and in May 1914 the new designer went to the Aircraft Manufacturing Company's new works at Hendon. There he encountered F. E. M. St. Barbe who had joined Airco in 1912 as a premium pupil. It is to be noted here that Frank Hearle who had left Farnborough and visited the United States on behalf of Vickers did not rejoin the D.H. team until 1917

PROGRESS.—Top to bottom, the B.E.2, the D.H.1A, the D.H.16 (G-EAQS) used by Air Transport and Travel on its Hounslow-Paris Service. The D.H.66, Hercules, used by Imperial Airways. The Flamingo used on the Channel Islands service just before the War.

when he became manager of the Airco experimental department.

And so the stage was set at the new Hendon works of Airco for the First World War in which the company was to build a series of aeroplanes, a majority of which were to become household names with the identification D.H. and a number. They ran from the D.H.1 which was a two-seater pusher biplane engine first with the 90 h.p. and later the 120 h.p. Beardmore to the D.H.10 which began as a biplane bomber with twin Puma pusher airscrews and ended up as a twin tractor with two Rolls-Royce or with two Liberty engines.

The D.H.2, a single-seat pusher with the Mono Gnôme, was built in quantity. The D.H.4 was a particularly significant creation. Designed to have the 240 h.p. B.H.P. it went into service with the 325 h.p. Eagle and in side elevation shows the line de Havilland was to make classic. From it sprang the D.H.9 with the 240 h.p. Siddeley Puma which was developed from the B.H.P. (in which the H. stood for Halford). The D.H.9A with the 400 h.p. Liberty remained in service for years. By the end of that War it has been established that one-third of the total allied air strength and 95% of American aircraft production were machines of de Havilland design.

The Hard Way to the Stars

After the Armistice and during the prolonged Peace Conference in Paris, D.H.4 and D.H.9A aeroplanes modified with cabin tops were kept busy carrying officials. Moreover on Aug. 25, 1919, Air Transport and Travel Ltd. inaugurated international air travel with D.H.9 machines. A modified D.H.4 with clipped lower wings won the Aerial Derby of 1919.

It was not long before the bottom had pretty well fallen out of the aviation business. In 1920 the Birmingham Small Arms Company which had acquired Airco were glad to dispose of it and, as we have recorded earlier, it was because of this that the de Havilland Aircraft Co., Ltd., came into business on Sept. 25 of that year. Its founders had paid £1,875 into the bank as working capital and of this £834 had been paid to Airco for equipment, materials and work in progress. But poor though they may have been in capital, the founders were rich in experience.

The founders of the business were led by Captain Geoffrey de Havilland and Mr. C. C. Walker on the technical side. M. F. T. Hearle was works manager, Mr. W. E. Nixon the secretary and Mr. F. E. N. St. Barbe the business manager. Mr. A. E. Hagg was in charge of the drawing office. The only order on the books was the completion of two half-built D.H.14s for the Air Ministry.

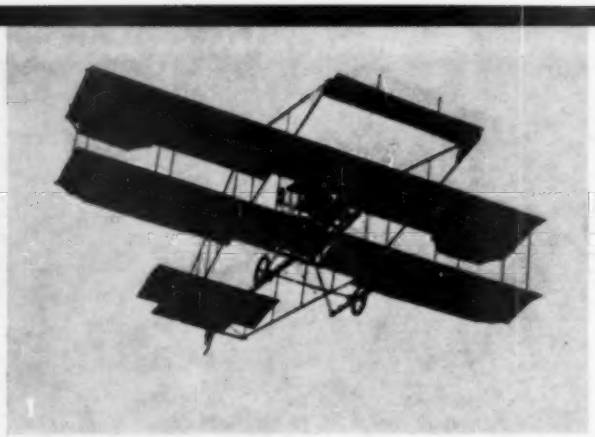
It is worth noting that even in these difficult days, the training of staff was not overlooked. When the apprenticeship scheme was started in 1921, a youngster called Bishop joined in June of that year as the second apprentice. He was to become famous as designer of the Comet.

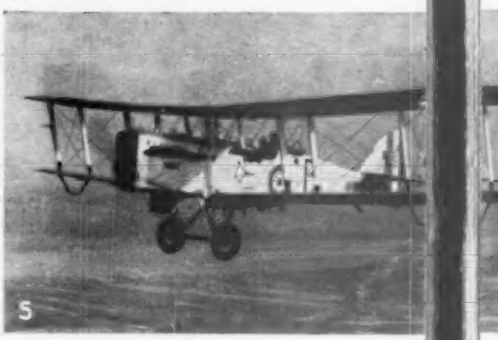
The first D.H. monoplane was soon flying. The D.H.29 had a high cantilever wing and a 500 h.p. Napier Lion. The pilot was in the nose and a cabin carried 10 passengers. However, the fore-and-aft control was not satisfactory, and as the Daimler company wished to take delivery of eight machines in the early spring of the next year, it was decided to drop the 29 and go ahead with the D.H.34, which was a direct development of the D.H.18. It is an interesting thought that as a result of this decision the British airline business was to wait for many years before it got its first high-wing passenger monoplane. De Havilland themselves were not to build one until the all-metal Flamingo was produced, just before the outbreak of World War II.

Meanwhile, the aerodrome at Stag Lane had been bought for £20,000, of which £2,000 had been paid down as deposit. About this time Mr. Alan S. Butler was negotiating with the company for a private owner's aeroplane with a Rolls-Royce Falcon. He became so interested that he put some thousands of pounds into the company and two years later, in February, 1924, was made chairman, a post he retained until June, 1950.

The D.H.34 duly flew in March, 1922, and, in all, a dozen were built. It is interesting to note that one was sold to the Russians. Between April and December of that year a D.H.34 of the Daimler fleet flew 100,000 miles without failing to complete a trip. Two years later another was to average of five hours' flying a day (or utilization as we should say now) during June, 1924, with 18 round trips to Berlin, eight to Paris, five to Cologne and four to Amsterdam.

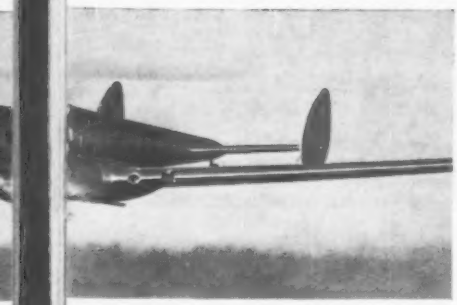
(*Continued on page* 248)

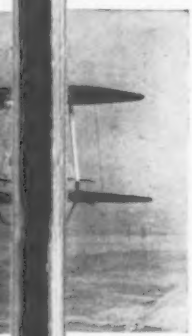




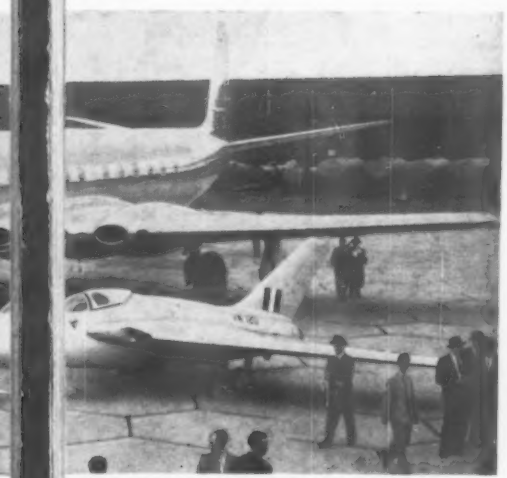
Names That Made History

6. "Grosvenor House" the Comet Racer (D.H. 88) in which C. W. A. Scott and Campbell Black flew from Mildenhall to Melbourne in 71 hours in 1934.
7. The Comet prototype and the D.H. 108.
8. The D.H. 84 Dragon in action as an air ferry to the Isle of Man.
9. A D H. 108, a Vampire, a Hornet and a Mosquito on show at Radlett in 1946.
10. Alan Cobham chatting to Sir Sefton Brancker alongside a D.H. 50, with which they flew to Rangoon in 1924.
11. Stag Lane as those who saw it will always remember it.





1. Geoffrey de Havilland's second aeroplane flew on Sept. 10, 1910, with a 45 h.p. D.H. engine.
2. The 4-engined all-wood Albatross with which Imperial Airways did the London–Paris service in an hour.
3. The D.H. Canadian-built Caribou.
4. Hubert Broad running-up the D.H. 71 Tiger Moth with the 85 h.p. Cirrus engine in the 1927 King's Cup Race. The first D.H. 71 that achieved 186 m.p.h. had the prototype Gipsy engine.
5. An operational D.H. 9A with spare wheel clamped under the fuselage.



(*Continued from page* 245)

In 1924 the King's Cup Race round Britain was won with the D.H.50 flown by Alan Cobham. It was a four-seat cabin version of the D.H.9 and had the 240 h.p. Puma. It had first flown the previous year and was to appear in a number of variants. Cobham flew one of them to Rangoon and back, to Capetown and back, and to Australia and back, all in the course of two years.

In September, 1926, the D.H.66 flew. It had been produced to an Imperial Airways formula. Eleven were built and, known as the Hercules, this 12-seater biplane with three 500 h.p. Bristol Jupiter engines, two on the lower wing, had a successful career on Imperial's routes for a long time.

But while these transport machines of classic shape were coming forward, the de Havilland company had started something which not only began an era, but brought the company international fame. In 1923 the Air Ministry held a competition for light aeroplanes; ultra ultra-light they would be called today, for the engines were limited to 750 c.c. capacity. Some remarkable machines were built including the D.H.53 Humming Bird, but when next year the Air Ministry called for entrants for a two-seater competition limited to engines of 1,150 c.c., Geoffrey de Havilland refused to compete and decided to build a machine with a much larger engine. He was convinced that 60 h.p. was needed for practical flying. And as a practising aviator since 1910, he might have been expected to know.

How an Engine was Born

In that year, because a batch of R.A.F. "90" engines became available at a ridiculous price, the D.H.5L 51 was produced. It did not catch on and only three were built. Nevertheless, one of the three is flying in Kenya to this day.

Before the D.H.60 could be built an engine had to be found. As we have said, Capt. de Havilland had decided that 60 h.p. was the power required and the original allowance was to be 350 lb. Consultation with Frank Halford established the possibility of using the surplus cylinders of the R.A.F. "90" engine arranged four in-line on a new aluminium crankcase with aluminium cylinder heads. The result was the Cirrus.

On Feb. 22, 1925, the first Moth was flown by Capt. de Havilland himself and proved a winner from the start by winning the 1926 King's Cup. The type became the mainstay of the newly founded light aeroplane clubs. Moths have been flying ever since and still win races.

The next step was to produce an engine specifically for the Moth, and Frank Halford undertook to design it. The prototype was out in 1927 and, in the September of that year, a specially built monoplane racer, the Tiger Moth, D.H.71, appeared. Built around the small figure of Hubert Broad, by then the company's chief test pilot, it put up a World record with a speed of 187 m.p.h. It eventually did 200 m.p.h. The engine was derated for production purposes and became the first of the long line of D.H. Gipsy engines. Deliveries began in June 1928.

By the time 1930 had arrived, Moths were an international household name. In that year Amy Johnson and Francis Chichester had flown Moths solo to Australia. In April, 1913, C. W. A. Scott flew from England to Australia in nine days four hours. In July, Jim Mollison flew from Australia to England in eight days 21 hours.

But the fertility of private enterprise development at Stag Lane did not stand still and by 1929 another D.H. aeroplane had appeared to set a standard all its own. This was the D.H.80, the Puss Moth. The low slim lines and the situation of three-seat cabin under the folding wings had been made possible by the successful inversion of the Gipsy engine so that the inverted crankcase formed the top of the cowling. This led to the production of the Gipsy III engine.

The combination of so many new features was more successful than expected and the Puss Moth came out seven miles an hour faster than calculated. Some three hundred were sold; more than any other inter-Wars type except the Moth (1,800) and Tiger Moth before September, 1939.

Bert Hinkler flew one from New York to London via the South Atlantic.

Another Puss Moth was flown to Tokyo and back by Amy Johnson. In those days the de Havilland advertisements used to feature a stormy seascape perceived through the slogan "A Gipsy never lets you down." And in those small single-seat aeroplanes the engines had to run for an awful long time. It took Mollison over thirty hours to do 2,600 miles across the North Atlantic.

The period around 1930 was one of depression and things were not easy but the site at Hatfield was bought and preparations made to move the aircraft division there from Stag Lane. Around this time the Moth had been refined into a primary trainer with inverted engine, staggered and sweptback wings, and aerobatic certificate up to 1,750 lb. In the years of growing tension in Europe the Tiger Moth was adopted by some 25 countries in five continents. Before the Second World War broke out 1,390 had been built in England, Canada and Australia.

But neither the Puss Moth nor the Tiger Moth represented the limit of what could be achieved with the low-powered Gipsy series. The Fox Moth, a return to the earliest D.H. conception of the biplane passenger carrier with the cabin between the biplane wings and the pilot well aft, carried pilot and four passengers on 130 h.p.

In August, 1932, design was put in hand of a twin-engined passenger carrier with two 140 h.p. Gipsy Majors using standard Moth wings as extension planes. On Nov. 24 of that year it flew. It carried six passengers, had folding wings and could certainly fly with full load on one engine. With this D.H. Dragon the celebrated Edward Hillman began his air service to Paris.

The appearance of the 200 h.p. Gipsy Six and the installation of this inverted engine in a cleaned-up version of the Dragon known first as the Dragon Rapide (and later by its sobriquet alone) resulted in a truly remarkable machine which made possible the operation of many an air route and airline. It was in steady production throughout the Second World War. Up to the outbreak of hostilities 100 Fox Moths, 115 Dragons, 130 Leopards, 75 D.H.86s, 170 Hornet Moths, 210 Rapides and 70 Dragonflies were built.

But although the four-engined D.H.86, another classic wooden biplane, had been hurried through for Qantas, the path on which the de Havilland sights had been set for so long, as the construction of the D.H.29 had shown twelve years previously, was marked by the design and construction of the Comet Racer built to win the great MacRobertson Race from Mildenhall to Melbourne which it did in the startling time of 70 hr. 59 min.

For the first time a British aeroplane had been designed around the concept of a multi-engined low-drag cantilever monoplane with variable-pitch airscrews and retractable undercarriage. The outstanding performance of this two-seater with its total power of 448 h.p. made a marked impression and as a result the company obtained an order for two Albatross mail-planes.

As the D.H.91 this all-wooden machine of 32,500 lb. all-up weight took off from Hatfield on May 20, 1937. It cruised at 210 m.p.h at 2¼ a.m.p.g. This too was a low-wing cantilever monoplane with retractable undercarriage but had four engines air-cooled and buried in the wings. Its engines were specially developed inverted air-cooled Vee twelve cylinders. Five more were built for Imperial Airways and in December, 1938, when they went into commission, they reduced the London-Paris time to within the hour.

But at the same time another significant development was taking place at Hatfield. This was nothing less than the production of an all-metal high-wing monoplane, the Flamingo, powered by two 890 h.p. Bristol Perseus sleeve-valve radials. This was a significant step along the path towards the high-performance civil aeroplane on which the company had so long set its corporate heart. It flew at the end of December, 1938, and six months later was on the Channel Islands service. The outbreak of war cut short its career.

Expansion to the Limit

During the ensuing six years de Havilland activities extended and extended. The fiercely individualistic business which had grown up around the genius of the young engineer who had built his first aeroplane and taught himself to fly on it in 1910, had diversified itself in a remarkable way. The basic root structure had spread and developed remarkable ramifications.

In the course of the history of the de Havilland enterprise, associated or affiliated firms had grown up in what in those days was still regarded as the Empire. The de Havilland Company of Canada had been founded in 1928 and the de Havilland Aircraft Proprietary Ltd., had been set up a year earlier. There was another company in South Africa.

This had all been achieved as a private business, but when the need came for expansion these firmly developed roots were available to support a remarkable tree. From 1939 until 1945 the de Havilland Enterprise built 5,584 Mosquitos, out of the total of 6,700 which went into service. It provided the major share of all the R.A.F.'s propellers, well over 100,000. Seven thousand Tiger Moths were built. The associated Airspeed company which had been taken over in 1940 had produced the Oxford twin-engined trainer, of which 8,750 were built up to VJ-Day and was later responsible for the Horsa glider, of which 3,600 were built.

A detailed analysis of wartime effort is not to be expected in this history which must be limited to setting forth the story of the de Havilland venture and its outcome.

(*Continued on page* 249)

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Yours faithfully,

Chairman
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Avery-Hardoll Limited offer sincere congratulations to the de Havilland Aircraft Company Limited upon the occasion of their 40th anniversary, and the 50th anniversary of Sir Geoffrey de Havilland's first flight on September 10th, 1910.

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(*Continued from page 248*)

In such an examination it is clear the story of the Mosquito must play an important part. The basic conception was a de Havilland idea and it was the company's (and let us add the country's) good fortune that in the person of Air Marshal Sir Wilfrid Freeman, the R.A.F. had produced a man of vision and determination who saw what was needed and saw to it that the dream was realized.

One day perhaps the country will realize what it owed to Air Marshal Freeman and a suitable posthumous tribute will be paid. Today few people seem to realize how important was the part he played in ensuring that the Royal Air Force had the best equipment the country could provide and in the quantities needed. He was a man not to be dissuaded by popular lack of regard.

Back in 1938 the possibilities of the high-speed unarmed bomber were being examined. It is to be noted that the same concept had occurred to the Germans and Dr. Heinkel had elaborated the theme in a classic lecture given in this country.

Second Thoughts Save the Mosquito

The de Havilland concept was not enthusiastically received here and indeed when the design was five months on its way, it was dropped on instruction from the newly set up Ministry of Aircraft Production. But second thoughts prevailed and thanks to its all-wooden construction and the fact that it would therefore use the production capability of otherwise untappable production sources, it was reinstituted. The first Mosquito flew on Nov. 25, 1940. By the time the last machine left the factory, as we have said, nearly seven thousand had been built. The R.A.F. flew their first Mosquito sortie just under a year later, on Sept. 20, 1941.

There were about 20 principal marks. To those familiar with development at that period, it seemed that every new mark was carrying a bigger bomb just that much farther.

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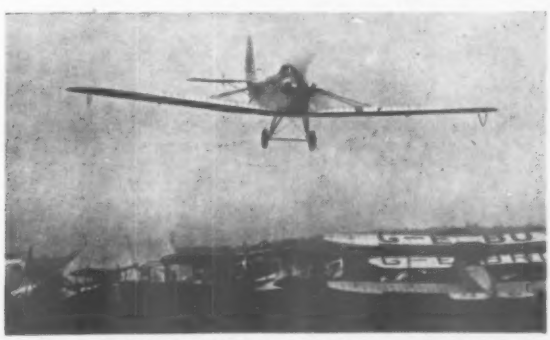

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Known as the D.H.103, the latter was to become famous as the Hornet and first flew at the end of July, 1944. In this machine, with its composite metal and wooden construction, Redux was used for the first time. With oppositely rotating airscrews and Merlin engines giving over 2,000 h.p. each for take-off, the Hornet had an outstanding performance.

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Early flight testing was done in a Gloster Meteor which it will be remembered originally flew with Whittle (or Power Jet) engines. With two Goblin engines the Meteor test-bed was flying on Mar. 5, 1943, 11 months after the first test-bed running of the engine.

Vampire flights began at Hatfield six months later on Sept. 20. The family tradition was observed and young Geoffrey de Havilland was the test pilot. After some 30 hours of test flying a Goblin was sent to the Lockheed company at Burbank for installation in their XP 80A, which flew in January, 1944, attaining 500 m.p.h.

In spite of all this development, production of Gipsy engines went steadily along and by the conclusion of the War 10,212 engines had been manufactured at Stag Lane, made up of 7,795 Gipsy Majors, 1,264 Gipsy Queens for fixed-pitch airscrews and 1,153 Gipsy Queens for variable-pitch airscrews.

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By the time fighting in the Second World War had ended in Europe the de Havilland organization had grown to something so vast as to have seemed almost inconceivable to those who had watched its beginnings at the end of the First World War. But as was not the case in those difficult struggling days 25 years earlier, the World in 1945 had a need for air transportation, and not only that to be provided by the enormous number of wartime transport aircraft available. Operators were eager for new types.

This perception of the existing need was shown by the production of the twin-engined Dove (D.H.104) which flew for the first time on the company's 25th birthday, Sept. 25, 1945. Out and airborne within six weeks of the end of the War the Dove, its makers believed, would find a very large and world-wide market because of its small size. It was suitable, they claimed, not only for scheduled airlines but also for charter operation and was, in addition, they claimed, an admirable vehicle for executive travel and private ownership. This belief in the contemporary high performance of the machine, made possible by the new Gipsy Queen 70 geared and supercharged engines, was completely justified. Over 515 Doves had been sold by the middle of 1960.

In the meantime, Dragon Rapides, built during the War as Dominies, had been sold to some civil operators and the demand for this efficient pre-War designed biplane transport was such that 100 had been sold before the end of February, 1946. Among those first to use them were K.L.M. Another pre-War type called for after the War was the Fox Moth, and a number were built in Canada to meet the demand.

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●

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(*Continued from page 248*)

In such an examination it is clear the story of the Mosquito must play an important part. The basic conception was a de Havilland idea and it was the company's (and let us add the country's) good fortune that in the person of Air Marshal Sir Wilfrid Freeman, the R.A.F. had produced a man of vision and determination who saw what was needed and saw to it that the dream was realized.

One day perhaps the country will realize what it owed to Air Marshal Freeman and a suitable posthumous tribute will be paid. Today few people seem to realize how important was the part he played in ensuring that the Royal Air Force had the best equipment the country could provide and in the quantities needed. He was a man not to be dissuaded by popular lack of regard.

Back in 1938 the possibilities of the high-speed unarmed bomber were being examined. It is to be noted that the same concept had occurred to the Germans and Dr. Heinkel had elaborated the theme in a classic lecture given in this country.

Second Thoughts Save the Mosquito

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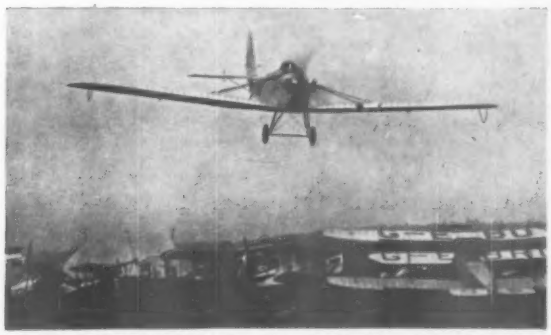

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already noted, the Vampire was continuing to come off the English Electric Line at Preston since the D.H. factories were fully occupied. Sweden, the first large overseas buyer of the Vampire, signed a contract for this type in early 1946.

From the end of the War, design teams were at work on the Comet and, down at Christchurch in the airspeed factory, on the Ambassador. Before the Comet, however, a necessary step was taken with the production of the elegant tailless D.H. 108 propelled by the Goblin which delighted audiences at post-War S.B.A.C. Shows in the skilled hands of young Geoffrey de Havilland, who was later killed doing speed trials in this machine over the mouth of the Thames on Sept. 27, 1946. Two years later a D.H. 108 piloted by John Derry was the first British aeroplane to exceed the speed of sound (Sept. 6, 1948).

However, early trials had shown that the tailless shape was not economical and the Comet design policy had been finally settled in September, 1946. The first flight of the D.H.106 was on Jly. 27, 1949. In spite of the fact that the jet-propelled transport, turbine-engined, was an absolute novelty, the Comet went into service with B.O.A.C. within three years on May 2, 1952, and immediately established itself as the air transport aeroplane of the era. Passengers were enthusiastic in their praise and the turbines in operation disclosed unexpected economy. The first orders were for fourteen machines plus two aircraft for M.o.S. In the first year operation of the new type proved profitable. Early in 1954, first on Jan. 10 and then again on Apr. 8, occurred the disasters which brought the career of the Comet I to an end.

Developments went ahead on the Comet 3. As developed Avon engines became available, the design crystallized as the Comet 4. Meantime the R.A.F. had taken 10 Comet 2s in which the original design had been modified to new structural standards. As far back as 1949 the Comet had shown what the jet age traveller might expect by bringing Rome within two hours of London. The R.C.A.F. had their Comet 1As similarly modified. It is interesting to reflect that the Comet 2s of Transport Command have clocked 30,000 hrs. to date.

We should go back here to 1947 when the Ambassador, built by the Associated Airspeed organization, first flew. On the services of B.E.A. between March, 1952, and July, 1958, this machine, with its high wing and long slender fuselage, became a favourite and totalled some 31,000,000 miles flying. Over 2,400,000 passengers were carried.

Earlier, reference has been made to the steady demand for the Vampire. These sales inaugurated a long train of similar successes to Commonwealth and friendly foreign countries. To meet the need for productive floor space, the big Shadow Factory at Chester was leased from the Government in the summer of 1948. In the subsequent 11 years more than 3,500 aircraft were produced there.

The Vampire was followed in R.A.F. service by the Venom which had the bigger Ghost engine and enhanced performance. Overseas sales of the type were negotiated, but not to the same extent as for the predecessor, but overseas business did lead to two-seat versions of both machines. As a result, the Vampire Trainer and Night Fighter, the Venom Night Fighter and Sea Venom came about as natural developments.

The next D.H. military aircraft for the Services was the Sea Vixen, the D.H. 110 which completed its carrier trials in April, 1956 and went into service with the Royal Navy. Production of the Sea Vixen for which the order was placed in January, 1958 for the Royal Navy continues. The present contract for this two-seat naval all-weather fighter should keep capacity for the type occupied until 1963. Further orders are expected.

When the four-engined Heron appeared in 1950 to provide a roomier aeroplane for the operators than the Dove, yet making use of the same parts wherever possible, it had a fixed undercarriage. This 14-seater, low-wing monoplane, the D.H. 114, of which later versions had retractable undercarriages, sold steadily and up to the present time some 140 have been bought.

It took over four years for the causes of the Comet accidents to be established and for the new design to be developed, for fresh production to be established and the enlarged, re-engined machines to be put into service again. Nevertheless, so far had the conception been ahead of its time that the Comet 4 was the first civil jet transport to go into service over the North Atlantic. B.O.A.C. opened the service on Oct. 4, 1958.

It was during this period that the last chairman of the company, Sir Aubrey Burke, transferred from the engine company at Leavesden to concentrate on aircraft production. On taking over, he inaugurated a big drive into reorganizing work at Hatfield, and it was this that brought the Comet back onto the air routes of the World in double-quick time once the design had been finalized.

Some time before the Comet 4 re-entered service, negotiations had been taking place with B.E.A. on the subject of a replacement for the Comet 4B, the version of the Comet 4 with a lengthened fuselage but shorter wing. The Corporation had bought it in order to meet competition on their long-haul continental routes. As always, the de Havilland Company had firm ideas about the characteristics likely to command the widest World market at the time when the new trimotor Trident would be appearing. The negotiations with B.E.A. which had taken place in 1957 were approved by the Government on Feb. 12, 1958.

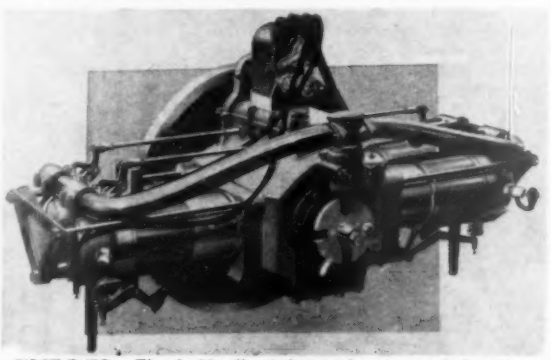
It was not until Aug 12, 1959 that the contract for 24-5 D.H.121s were signed. There is an option for a further 12. At that time the aircraft was to be produced by a consortium, but the subsequent regrouping of the industry has rendered that unnecessary.

Of this machine Sir Aubrey Burke recently reported that the interest expected by the company in the design has been evident in all the principal markets of the World. The Trident which is to have Rolls-Royce R.B.163 engines, is capable of considerable development to meet the needs of operators having requirements which differ from those of the first buyer. More than one version is planned in order to meet requirements in the whole World market for short and short-medium ranges.

The Engine and Propeller Companies

Since the War two associated companies have contributed much to the expanded fortunes of the de Havilland Company. First the de Havilland Engine Company whose great achievement in producing the Goblin turbine has already been recorded. The D.H. Engine division, which dates back to 1927 at Stag Lane, was formally constituted a separate company in 1944.

Following the end of the War a new range of Gipsy engines was introduced. First there were two versions of the four-cylinder Gipsy Major: the 200 h.p. supercharged "50" and the 215 h.p. version known as the Gipsy Major 215, for helicopters. There were various versions of the six-cylinder Gipsy Queen. The Gipsy Queen 30 (direct drive, unsupercharged), gave 250 h.p. There were three marks of the geared and supercharged Gipsy Queen 70. The Mark 1—340 h.p., Mark 2—380 h.p. and Mark 3—400 h.p.



FIRST EVER.—The de Havilland designed water-cooled engine installed in Captain de Havilland's first aeroplane and successfully flown in the second.

In the jet engine field the wartime Goblin was followed by the Ghost (5,000 lb. static thrust) designed in 1945. A civil version of this engine was developed, starting in 1947, for the first Comet jet airliner. The Ghost was also used extensively in the Venom fighter.

The next development was the Gyron, intended primarily for supersonic flight. It was designed to give 15,000 lb. with promise of development to 20,000 lb. It first ran in January, 1953. By 1956 Gyrons were developing 25,000 lb. dry thrust and have subsequently been run at 29,000 lb. with reheat.

A scaled-down version of the Gyron followed. Known as the Gyron Junior, it first ran in the summer of 1955, the year in which Frank Halford died at the height of his powers. This engine was specified for the Saunders-Roe P.177 which was dropped. It is currently used in the Blackburn N.A.39 and the Bristol Supersonic aircraft.

The first product of the Engine Company's Rocket Division was the Sprite, a liquid fuel assisted take-off rocket engine designed to suit the Comet. It was found to be unnecessary for this but was developed as the Super Sprite for the Valiant bomber.

This rocket engine was followed by the Spectre, controllable within the range 1,000 to 8,000 lb. of thrust, and intended for the mixed-powerplant conception for supersonic aircraft. Another version of the Spectre was produced as an assisted take-off engine for the Vulcan and Victor bombers. The latest development of the rocket engine is the Double Spectre which

(*Continued on page 251*)

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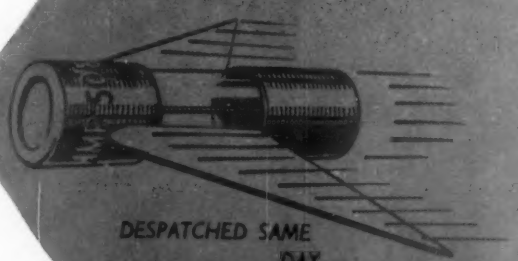

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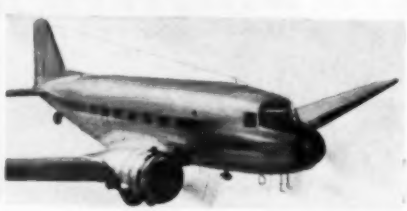
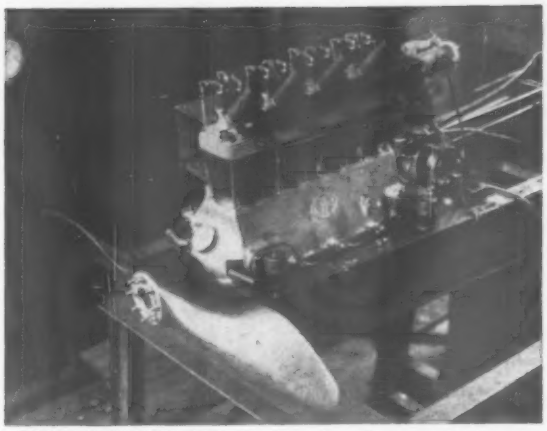




FAMOUS PROGENITOR.—In these days of supersonic Gyrons this photograph of the prototype Gipsy I is a reminder of how it all started.

(*Continued from page 250*)

is being used to power the test vehicles for the Blue Steel stand-off bomb.

In February, 1958, the D.H. Engine Company announced the Gnome turbo-shaft engine, a 1,000 s.h.p. unit suitable for turbo-propeller aircraft or helicopters. The engine is manufactured by agreement with the General Electric Company of America.

De Havilland Propellers, Ltd., was formed as a separate company on Apr. 27, 1946, and in that year a new factory at Hatfield was completed.

The first post-war aircraft to have D.H. propellers included the Avro Tudor, the Handley Page Hermes, the Bristol Freighter, the Vickers Viking, the Miles Marathon and Merchantman, the Percival Prince, the Airspeed Ambassador and the de Havilland Dove.

The first official type approval for a turbine propeller (tested on a Bristol Theseus) was obtained in 1946, and the first British type approval for a reversing propeller was gained in March, 1947.

In 1951 the decision was taken to undertake guided weapon development, resulting in the Firestreak air-to-air missile. In August, 1957, it was announced that the Propeller Company had been appointed the overall design authority for Blue Streak long-range Ballistic Missile.

Following Firestreak the Company is now working on a new and more advanced air-to-air missile known as Red Top.

First steps taken towards the manufacture of other aircraft equipment, including air conditioning systems, alternators, radar scanners and, latterly, fuel-control systems, were taken in 1951. The Company also manufactures a new type of flowmeter.

Overseas Companies

After the War the Australian company designed and built the Drover, a three-engined transport intended specially for the Australian market. It had three Gipsy Major engines and first flew in January, 1948. It is still in service with Fiji Airways and with the Flying Doctor Service. Some Drovers are being modified to take three Lycoming engines.

Since production of the Drover ended, D.H. Australia has been building Vampire Trainers for the R.A.A.F. and maintaining Sea Venoms for the R.A.N. Early in 1960 D.H. Australia leased the Commonwealth Government Engine Factory at Lidcombe, N.S.W., where are now located the company's Propeller Division and Engine Overhaul Section, the largest engine and propeller overhaul facility in Australia.

When the fighting stopped the Canadian company wanted to produce a STOL transport but the parent company persuaded them to respond to the R.A.F. need for a new trainer to replace the Tiger Moth, and if successful with that project, to tackle the STOL transport aircraft second.

Outcome was the Chipmunk, a worthy successor in the training field to the Tiger Moth. Designed by Jakimuik and team under Doug Hunter, Director of Engineering, it first flew on May 22, 1946, at Toronto. Pat Fillingham from Hatfield was the pilot. About 200 were built in Canada, and thereafter more than 1,000 produced by de Havilland at Hatfield and (mainly) Chester for the R.A.F. and many overseas air forces. After the military requirements had been met, the Chipmunk reached the civilian market.

Early in 1947, the DHC2 project was announced. It was to become famous as the Beaver. Meanwhile, some 50 Fox Moths had been built by DHC to meet the urgent need of Canadian bush operators. The first flight of the Beaver was on Aug. 19, 1947, by Russ Bannock, ex-R.C.A.F., post-war director of the Canadian Company. There were 1,400 Beavers in World service by the end of 1959.

To utilize factory capacity, DHC built a quantity of Grumman CS2F-1 Tracker aircraft for R.C. Navy from 1956-1959.

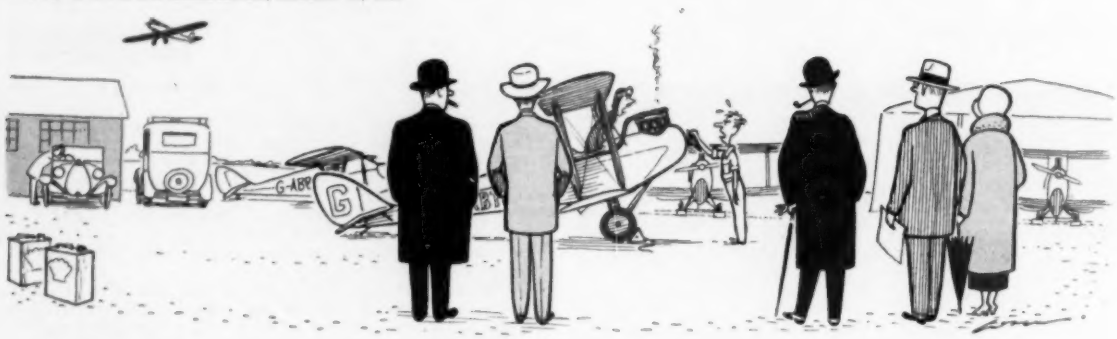
Following the Beaver, or "half-ton truck" as it was regarded, came the DHC3, the Otter, which was equivalent to a "one-ton truck." First flight was on Dec. 12, 1951, by George Neal, chief test pilot of DHC. A total of 300 was produced by the end of 1959. Like its predecessor it was ordered in quantity for the U.S. Army.

First idea for the twin STOL was 13,000 lb. gross weight with two 600-h.p. Wasps, but further study showed need for 14-cylinder two-row R2000 Pratt & Whitney (DC4 engine) and gross weight of at least 24,000 lb., three times that of the Otter. First flight of the Caribou, the DHC4, was on Jly. 30, 1958, by George Neal, with co-pilot Dave Fairbanks. A successful world tour began in 1959 and ended early 1960. The original order for five of these versatile aircraft by the U.S. Army was later increased.

OVERSEAS SUCCESS.—One of the most successful post-war de Havilland designs, the Chipmunk, was designed by the Canadian company.

A few months before the company's 40th birthday and some 50 years after the first flight of a de Havilland aeroplane, the great D.H. enterprise with all its subsidiaries at home and overseas became linked with the Hawker Siddeley Group. As de Havilland's chairman, shortly after elected deputy managing director of the Hawker Siddeley Group, has said, the achievements of the de Havilland Enterprise have put the business on an increasingly profitable footing and thereby enabled the Enterprise to join the Group in the knowledge that "we shall make a strong and profitable contribution of great breadth to our mutual interests and that jointly we are fully equipped to match competitors in the World. We believe that together we have formed one of the World's greatest industrial enterprises which has the publicly announced support of the Government."

To all who have read this fifty-year history it has been made clear, we are sure, that the enterprise, initiative and endeavour of all those who have worked together so well and for so long have provided the basis for even bigger and better things ahead.



Stag Lane and All That

At D.H.s a generation ago — by O. W. H. Cooke

WHY is it that certain persons, or bodies of persons, inspire on first acquaintance a loyalty which is to last a lifetime—and that without any detectable special effort to win allegiance? I wish I knew. But there it was and there it is with de Havillands. I thought for a while that this was a personal idiosyncrasy of mine until I came to discuss the tragic débâcle attendant upon the early Comet airliner with some of my contemporaries, all of whom had left the company many years before. Then it appeared that subconsciously we all felt the blow as a personal one.

I joined the de Havilland Aircraft Company (then a private limited company) in 1928, eight years after its foundation. I had already known Francis St. Barbe, then business manager and an original member, for some years, and one day on the old South Beds golf course he offered me the editorship of the *D.H. Gazette*. I had lately been called to the Bar and was dithering whether to set about practising or to pay heed to the obvious signs of overcrowding at that time in that branch of the legal profession. We were on the 10th green and I made a private compact with myself that I would accept if I holed my putt of six or seven feet. The putt went in and I started work at Stag Lane on the following Monday, becoming the firm's first publicity manager a month later.

The chairman of the company was A. S. Butler, and the resident heads of the firm were "D.H." himself—then Captain Geoffrey de Havilland, later to become Sir Geoffrey—(director and chief designer), two further directors in the persons of C. C. Walker (chief engineer) and F. T. Hearle (general manager), W. E. Nixon (secretary), F. E. N. St. Barbe (business manager), while H. S. Broad was the test pilot. I had met C. C. Walker at golf and I had been at Aldenham with Hubert Broad (where we both played side-drums in the O.T.C. band!). Otherwise all the faces were new to me.

My first impression was of the unaffected approachability of each and all of these "big shots," from "D.H." downwards. Here, it seemed, was a common sincerity of purpose and a total absence of mystery-making, backbiting and money-grubbing. There was a worthwhile job to do and we had the brains and resources to do it: very well, then, let's get on with it, and the rewards will come along—at any rate, that is the feeling I got as a newcomer, and the one which stayed with me throughout my time. And I think it likely that this spirit of frankness and cordiality was the root inspiration of that loyalty which is so evident.

"by" Bradshaw to Lympne..."

Next down the ladder came a coterie of lesser lights in which I found my place. No one who knew him will ever forget Ronald Malcolm, abounding in girth and good nature, who kept his own private Moth at Stag Lane, in which he and I used frequently to "do a Bradshaw" down to Lympne for a drink and fresh air on a summer's evening after work.

Then there was Jimmy White, chief instructor of the D.H. School of Flying, with his nervous eye whose rate of nictitation was, so Jimmy himself said, a reliable indication of the progress of the party; some of his assistants, notably the redoubtable Bob Reeve and the quiet-voiced Eddie Fulford (some said a dark horse); W. T. W. Ballantyne, then St. Barbe's assistant, who, already the possessor of a pilot's "B" licence, was having car driving lessons; and, making his appearance a few months after my own, C. S. Thom (whose demise, so recent and so untimely, I must mention), who came as St. Barbe's assistant in the room of Ballantyne, selected to go out to South America as firm's representative.

Later in succession came Hugh Buckingham, Geoffrey Jnr. and Peter de Havilland. Hugh Buckingham will forgive me if I put on record a classic remark of his, which must have enhanced the firm's prestige. Our newly appointed Swiss agent, one Batsholtz, reputed a multi-millionaire in Swiss francs, owned amongst other cars a magnificent Bugatti of some 10 litres capacity; at this time Buckingham ran a most decrepit and shot-at ancient small Bugatti of uncertain vintage. Upon being shown the superlative and vast carriage by its unassuming owner, Buckingham remarked, "I also own a Bugatti."

There was a small canteen in a cottage used by the top people for lunch. Although we lesser fry were accorded, most of us, the privilege of entrée here, and from time to time put in an appearance, there was very little room and we usually gathered for lunch at the "Bald Faced Stag" on the Edgware Road at the end of Stag Lane, whose Mistress Quickly was that imposing figure Mrs. Skinner.

In the evenings we usually met again at the "Stag," and were joined from time to time by such congenial spirits, each a wit in his own right, as Sydney St. Barbe of evergreen memory (then sky-writing with J. C. Savage), Ivor McClure, head of the aviation department of the A.A., and Charles Barnard, personal pilot to the Duchess of Bedford. While we enjoyed "a few for the road," Sydney would perhaps dilate upon the shortcomings of some Crowned Head of Europe when compared with a corporation dustman, Ivor would experiment to evolve a cocktail that changed colour and whistled in your gullet as you drank it, and Charles might tell the story of the Duchess's comment on his forced landing at Bushire.

It appeared that Charles was confronted with a dead propeller in Her Grace's Fokker-Jupiter "Spider" immediately after take-off, with a prospect ahead of rocks and boulders "as big as a house." Despite the rarefied air due to height and heat Charles somehow managed to get back and land in one piece on the aerodrome. "What's happened now?" asked the Duchess, who had settled down to writing letters in the cabin. Said Charles, "I think a piston has seized, Your Grace." Back came the rejoinder, "That, no doubt, is because you forgot to oil it, Captain Barnard." The anecdote may be apocryphal, of course—who knows, except Charles Barnard? In that case it is unfair to the memory of a very gallant Edwardian lady; but it makes a good story, anyway.

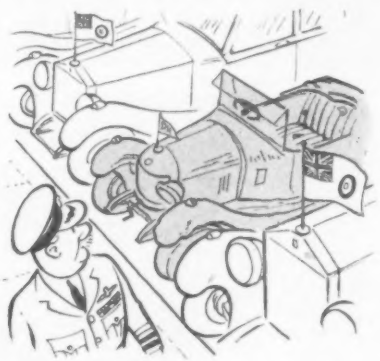
At that time the efforts of the firm were concentrated almost entirely on civil, as distinct from Service, aviation. There was a whisper that the Air Ministry found us a shade too independent for their liking and strangely reluctant to be dictated to in the matter of design; and it might even be that they sensed a certain incongruity, almost suggesting thumb to nose, in the sight of C. C. Walker's mud-caked two-seater Morris (he

boasted that he had never washed it since new) parked in the sunshine outside Adastral House in the middle of a line of gleaming Rolls-Royces with chauffeurs dozing over the wheels. (*En passant*, independence later paid off in the case of the Mosquito, didn't it?) However that may be, civil aviation was going ahead as fast as we could push it.

Wherever in the World vast distances cried aloud for aerial transport, de Havillands were opening up. Hereward de Havilland was already forging ahead in charge of the Australian Branch Company, and R. A. Loader was launching another Branch Company in Canada, soon to be followed by Rod Douglas in South Africa and Dudley Crosbie in India.

Among aircraft actively in production, starting with the big stuff we had the D.H.66 Hercules, a three-engined biplane built to the special requirements of Major Brearley, of West Australian Airways, whose initial order was for three, and the D.H.50, single-engined, supplied in some quantity to Hudson Fysh, of Qantas, and others, including Alan Cobham for his circuses.

At the same time, as a venture we built two versions of the D.H. Hound, one with a Jupiter and the other with a Napier Lion, a general-purpose military machine which we hoped might be adopted in that category for the R.A.F., who had signalized their intention to replace their existing type. Although



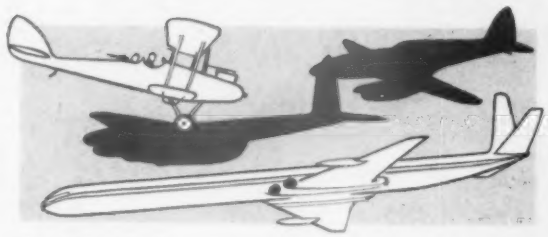
"..C.C.Walker's car..."

this aircraft (I think the Lion version) established a number of class records during its trials in the hands of Hubert Broad, it was passed over in favour of a machine which we considered inferior in every respect. (C. C. Walker's Morris again?)

Now to the bread-and-butter line, and perhaps the best known and best loved aircraft ever built—the ubiquitous D.H.60 Moth. There can, I think, be no two opinions on the statement that this was the first really practical light aircraft ever to be produced. Experience had already shown that smaller and lighter machines with exiguous engines could fly satisfactorily in good conditions—an example was the D.H.53 Humming Bird, with, I believe, a 6 h.p. engine. But now with expanding market potentialities at home and abroad, something more was required—a real aeroplane in miniature. "D.H." himself got down to the job and formulated his specification. To his mind the ideal private owner's machine for World-wide use and appeal must be a two-seater with at least some limited luggage capacity, uncomplicated, of rugged construction and easy maintenance as regards both airframe and engine, with orthodox and balanced controls, easy to fly with no vices, but sensitive enough to show up faults in flying, with sufficient available power, say a minimum of 60 b.h.p. or so, to combine a reasonable range and consumption with ample ability to cope with bad conditions and strong headwinds. A *gradual* stall at a reasonably low speed was indicated, but high all-out speed was relatively unimportant—such a machine would always be faster over the ground, and no more expensive to run, than a high-powered car. A suitable simple 4-cylinder aircooled engine was contrived virtually out of half an 8-cylinder Airdisco by that engineer of genius, F. B. Halford, and this was fitted. The result was the original Moth—a phenomenal success from the word go.

Soon other makers appeared on the market with machines in the same category. But to me none of these machines *looked* right in comparison with the Moth. (Why is it that all D.H. aircraft are æsthetically pleasing to the eye? Again I wish I knew—but they are.)

Then along came the D.H. Gipsy I engine—again Frank Halford—designed on the same general lines as the Cirrus, but improved and refined, followed by the Gipsy II, a little larger and further refined, and these were fitted into the Moth with



"all D.H. aircraft.. aesthetically pleasing.."

resultant improvement in performance. A brand-new engine factory had been built at Stag Lane and the firm went smoothly into engine production.

The advent of the Moth may be said to have sparked off and made possible a whole series of long-distance solo flights, many of them sponsored by that fairy godfather of private flying, Sir Charles Cheers Wakefield, later Lord Wakefield. Records were set up, broken and rebroken; sudden fame, and sometimes some fortune, came overnight to the "intrepid birdmen" (*vide* the popular Press of the time); and the Moth gained in reputation. One remembers at once J. A. Mollison, C. W. A. Scott, Francis Chichester (so lately in the news again), Amy Johnson and Jean Batten in connection with flights to and from Australia, while Lady Bailey, Lady Heath, R. R. Bentley, Tom Campbell-Black, Glen Kidston and Owen Cathcart-Jones were treating Africa to the same medicine—and a host of others besides. Even the Atlantic did not escape, and a little later Mollison might have been said to own it for single-engined machines.

All this time "D.H." was flying his own private Moth extensively and using his car as little as possible, and, just to show that we could do things at home Hubert Broad stayed aloft in a long-range Moth for 24 hours, during which he read five novels—a performance which captured the public's imagination to such an extent that you might have thought they had all been longing to do just that.

All this activity made my end of the stick quite hard work and absorbingly interesting. I had a good story to tell and I saw no reason for spending more of my employers' money than was strictly necessary in the telling of it. After all, the Moth, complete with all necessary basic equipment for normal day-to-day flying, cost no more than £750 (think of that, you surtax payers, when paying for your next inter-continental ballistic missile), and we had no lucrative side-lines such as fountain pens and cosy bedtime drink powders. So, in addition to a modest expenditure on space advertising, I went to town to get all the free editorial publicity I could.

I remember feeling amply repaid for my efforts in this direction when an old uncle of mine, who had retired as a full colonel without, I think, ever having heard a shot fired even in fun, but who played a bold hand with his whisky and his croquet, said to me one day, "Dammit, I can't open a paper without reading something about your blasted Moths. What's the matter with you?"

Space advertising had its lighter moments too. When the Gipsy engine appeared we wanted to advertise it in the technical Press. Well, there isn't much to say about a new engine apart from its specification, and that we knew would appear editorially anyway. However, the engine gave 100 b.h.p., and that gave us an idea. We filled the space with just 99 horses in all attitudes and at all angles, titled it across the bottom: D.H. GIPSY ENGINE—ONE HUNDRED HORSEPOWER, and left it at that. I rejoice to say that there was more than one irate telephone call, and I am told there was much counting of horses in high places.

There was never a day for me without a good laugh. Once a week the firm "laid on" a hairdresser for the staff. Although normally one went along to a little room given over to him, I had got him one busy day to deal with me in my office. While the operation was in progress Mollison, who was staying at Grosvenor House after one of his flights, rang me up. His query necessitated reference to some papers, so I said, "Hold on a minute, it's a little difficult at the moment as I'm having my hair cut." Mollison's laconic reply was, "That's all right, old boy, take your time—I'm in my bath."

When reviewing the events of a past age of peace, prosperity and plenty, one inevitably dons the rose-tinted spectacles. But I think I can say of all of us that we worked pretty hard when on the job—the job was fun, and what more do you want?—and we played pretty hard when off it. We were not overpaid, any of us—there was not all that money in aviation in those days—but we got enough. And, the greatest assets in the world, we were young, we were fit and we were happy.

Flying the D.H.51

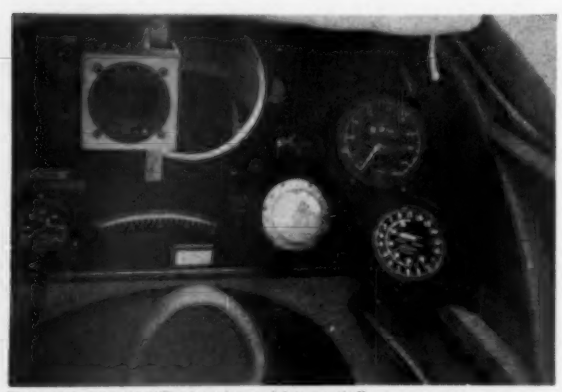
by John Fricker

BY a happy chance, in an issue which pays tribute to the fortieth birthday of the de Havilland Aircraft Company, we are able to include a current flight assessment of its oldest surviving product, the D.H. 51. If this type number is unfamiliar it is hardly surprising, since only three examples of this design were built three or four years after the de Havilland company started business at Stag Lane, but the design was important in being the immediate lightplane predecessor of the first of the famous Moths.

The D.H. 51 may therefore be regarded, with some justification, as one of the keystones on which the imposing edifice of British pre-War light aeroplane design rested, and it is remarkably fortunate that one of these three machines has not only survived the perils of old age, but still has a current C. of A. Perhaps even more remarkable is the fact that this near-miracle has happened not in the temperate air of the aircraft's birthplace, but under Africa's savage sun, the surviving D.H. 51, VP-KAA, being the first machine ever to be registered in Kenya.

" Miss Kenya " owes her survival, of course, to rather more than good luck, during a naturally chequered career since her emergence from Stag Lane as G-EBIR in September, 1925. A lot of hard work went into the reconstruction and restoration of her aged airframe to its present pristine condition, and " Miss Kenya " is maintained with the veneration she deserves at the old Nairobi West airfield by a syndicate of enthusiasts in the East African Aero Club.

It was there that I was fortunate enough to be able to fly her, during a visit earlier this year to Kenya, thanks to the efforts of two of her custodians, Jack le Poer Trench and J. A. Johnstone. Before doing so, a discussion of the history of this remarkable old aeroplane proved most rewarding, over a glass of beer in the clubhouse, and I am indebted to A. J. Jackson's invaluable " British Civil Aircraft " for some of the additional details.



Photographs copyright "The Aeroplane and Astronautics"

Most of the original instruments are retained in the rear cockpit of the D.H. 51, supplemented by a relatively modern compass.

Above "Miss Kenya" as she is today, having her original four-bladed airscrew swung at Wilson Field, Nairobi. Right, the leading figures behind the restoration of the D.H. 51 were Mr. J. S. le Poer Trench (left) and Mr. J. A. Johnstone.

It seems that G-EBIR was the third and last D.H. 51 to be built, the design having originated coincidentally in 1923 with the release of a batch of R.A.F. 1A engines, which were available as war-surplus salvage at a reputed price of 14s. 6d. each. The prototype D.H. 51, G-EBIM, first flew with one of these in July, 1924, but was later re-engined with the 120-b.h.p. Airdisco because the single-ignition R.A.F. unit did not qualify for a C. of A.

This decision was accelerated by the four forced landings suffered by G-EBIM in a 'mid-20's King's Cup race between London and Newcastle, because of ignition trouble. Two more D.H. 51s (G-EBIQ and 'IR) were built with the eight-cylinder Vee Airdisco-Renault engine in 1925, and were originally test flown by Capt. Geoffrey de Havilland, as he then was, while another very well-known personality connected with the construction of these aircraft was Mr. R. E. Hardingham, now chief executive of the A.R.B.

Bob Hardingham tells the story against himself of how, after helping to build the machine, he replaced the handed carburetters of the Airdisco on their wrong cylinder banks. When he started up, the engine was at full throttle, and the aircraft, much to his embarrassment, stood on its nose.

Having received its initial C. of A. on Sept. 21, 1925, G-EBIR was then purchased by John Carbery and shipped to Kenya in January, 1926. By devious means of surface travel, including an ox-cart, the D.H. 51 reached Nyeri, and after assembly was first flown by her new owner on Apr. 4, 1926. She changed hands in June, 1928, on being bought by a syndicate which included Tom Campbell-Black (later to become so well known as a long-distance pilot), to qualify for the newly required flying

licences. In the same year, on Sept. 10, the D.H. 51 became the first aircraft to be registered in Kenya, as G-KAA, which was altered on Jan. 3, 1929, to the present VP-KAA with the introduction of colonial registrations.

" Miss Kenya " then fell on hard times, after her last full C. of A. on May 12, 1936, and she is alleged to have been impressed into the R.A.F. during the War, although never flown in her improbable military capacity. When next heard of, she was taken over by Mr. G. F. Baudet, a ground engineer, restored and flown by him until presented to the R.A.F. at Eastleigh, Nairobi, in May, 1951.

Unfortunately, " Miss Kenya " was damaged on landing at Eastleigh, and subsequently remained semi-derelict in a hangar until late in 1954. Then Mr. J. S. le Poer Trench, of Noon and Pearce Air Charters, with the help of the local A.R.B. representative, Mr. J. A. Johnstone, and East African Airway's Archie Watkins, who, as Kenya ground engineer No. 1, was familiar with VP-KAA from its earliest days, took over the airframe for complete reconstruction.

On examination, the engine was found to be in extraordinarily good condition, having flown little more than 400 hours, and all except one of the original sparking plugs could be retained. Most of the original fabric was found serviceable, but many other parts had to be remade from scratch. De Havillands helped as much as they could, but were able to supply only two G.A. drawings from which dimensional and rigging details had to be obtained. The drawings quoted the D.H. 51 as being " a two- or three-seat sporting machine " with a canvas seat in the front cockpit, which had a sliding coaming for adjustment to the desired capacity.

Reconstruction Aid

The wheels presented one of the biggest problems, the originals having been beyond salvage except for the hubs. These were used as a basis for new units, built up from sheet-steel discs with motorcycle rims. Although the original tyre sizes were no longer available, the Palmer Tyre Co. moulded a new pair to the correct size free of charge, and this assistance was typical of that received from many sources during the 18 months of reconstruction. Help has also continued from such organizations as Shell, for example, which donates 40 gal. of fuel per annum to keep the D.H. 51 in the air.

Since her re-emergence, in 1955, " Miss Kenya " has featured in many displays and air occasions, and has proved by no means a static museum piece. She even entered for the Kenya Air Derby a year or two ago, although out-handicapped at an estimated cruise of about 90 m.p.h., and made, perhaps, the longest flight of her career in January, 1956, when she was flown non-stop the 220 miles from Kitale to Nairobi.

She is, however, very carefully flown by the privileged members of her syndicate, and I was most conscious of the honour at being able to handle her at Nairobi's Wilson Field. She stood outside the Kenya Police Air Wing hangar immaculate in her silver dope, unmistakably de Havilland in her lines and resembling very strongly an oversized and unstaggered Moth. The relationship even to the much later Tiger is obvious, and is emphasized by such common details as the upper centre-section gravity tank, the ailerons on the bottom mainplanes only, and even the differential operating system for those controls.

Quite a sleek and attractive aeroplane for its day; and I found it slightly awe-inspiring to reflect that this machine was flying before I was born. Perhaps the only thing that really dates " Miss Kenya " is the starting technique—not that this is difficult, since frankly I was amazed how readily the Airdisco bursts into life, with a ripple of nodding tappets from the uncovered valve gear. But first it is necessary to lower the bottom cowling by withdrawing a long pin from the hinges, for access to the carburetters, which are primed by hand.

After that, the big wooden cruciform propeller is swung over on a few compressions to suck in the mixture, and a flick of the airscrew with one hand, while the " coffee-mill " magneto is wound furiously in the cockpit, feeds a big fat spark to the cylinders. A puff of blue smoke from the long exhaust pipes, and the Airdisco is murmuring away as quietly to itself as it first did 35 years ago.

While it was warming up I settled myself in the front cockpit, adjusting the unfamiliar and borrowed helmet and goggles, and fastening the enormously wide safety belt across my middle. I realized suddenly that the front coaming, with windscreen attached, did indeed slide backwards and forwards, to provide a variable-sized cockpit, and the cavernous space beneath stretching ahead to the front bulkhead could comfortably accommodate at least two people.

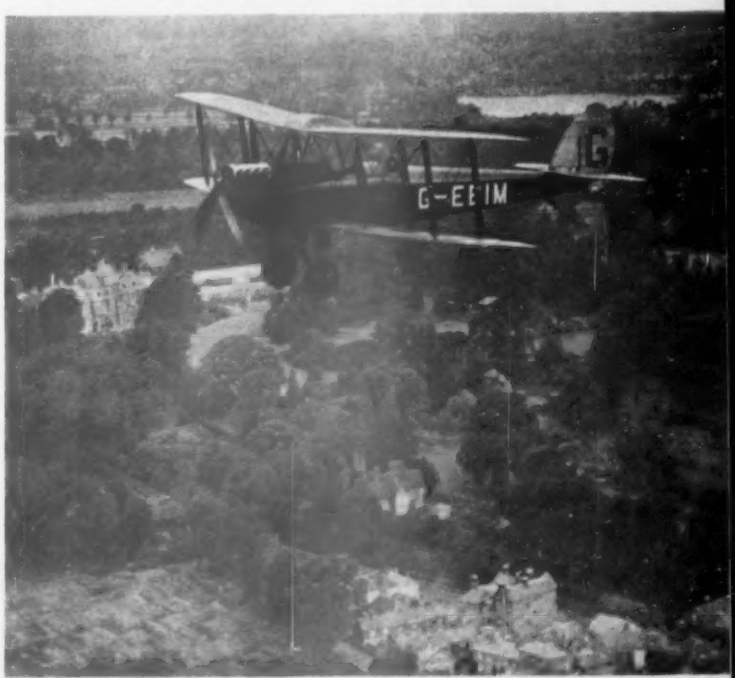
In VP-KAA, it is furnished very sparsely with dual controls, the rudder bar being uncomfortably far away, and having only an A.S.I. and an altimeter. I had previously noticed the splendidly vintage atmosphere of the rear cockpit, with its full set of six original instruments supplemented by a modern bowl-type compass as a concession to safety. The rear instrument panel also has a large circular hole for the well-being of the passenger(s) to be verified.

A Veteran in the Air

Immersed in a welter of wires below the centre section, I found the all-round view quite good except directly forward over the Vee-cylinder banks, and above where it is restricted by the upper wing. The Airdisco idled lumpily, with the geared airscrew flicking slowly round, but the engine became noticeably smoother as the throttle was opened for taxi-ing. This had to be done with extreme care on the tarmac apron, since " Miss Kenya " is naturally without benefit of brakes, and the tailskid had no purchase for rudder steering to be effective.

It was a squally afternoon at the start of the rainy season when I flew the D.H. 51, and the wind was boxying the compass, although blowing little more than a zephyr. When I lined up on the murram (red earth) strip at Wilson Field the windsock was pointing 90 degrees across our direction of take-off, and I was grateful that it was so light.

After an all-clear from Mr. le Poer Trench, in the rear cockpit, I gently opened the throttle, but I soon found that relatively little effort from the responsive rudder was necessary to keep straight. My initially coarse movements of the controls diminished in intensity as they came alive with increasing speed, biting on the sultry air of our 5,500-ft. take-off altitude. Despite this handicap, " Miss Kenya " ran for little more than 100 yards



These two pictures of the prototype D.H.51 were taken some 35 years ago from Stag Lane, and provide an interesting contrast with those on the opposite page. Above, 'IM is seen with the original 90-b.h.p. R.A.F. engine, while, left, it has become the D.H.51A with single bay wings and full-span automatic flaps.

before lifting off at about 55 m.p.h. I.A.S., and climbing sturdily away at around 60.

I made no attempt to measure the rate of climb, or indeed any other aspect of the D.H. 51's performance; this was an excursion into nostalgia, not a test flight, and I was determined to enjoy it. For that reason, I throttled back at little more than 500 ft. after take-off from maximum revs. of 1,900-2,000, to about 1,800 r.p.m. for the recommended cruise and headed over the game park next to the airfield in a gentle cruise at about 80-85 m.p.h.

Relaxing in the primitive wooden seat, I inhaled appreciatively the warm, oil-tainted slipstream from the dancing rocker arms flanking the nose, and marvelled at the subdued hum from the engine as the long exhausts flung its noise behind us into the African air. It seemed to me that the D.H. 51 was among the quietest piston-engined aircraft I had ever flown, and certainly there seemed no more agreeable sensation than floating low over the scenic bush country, with its teeming game, on the wire-braced wings of a bygone era of aviation.

Giraffe, buffalo and zebra pivoted round our inner wing tip as I forced the "Miss Kenya" into a steep turn, instinctively feeding in rudder to overcome the aileron drag heralded by the slight increase of slipstream on one cheek, and holding off a formidable amount of bank. I had been forewarned about the heavy lateral control, which is uncharacteristic of the machine, but is one of the things that takes too much time to get right in the absence of precise rigging information.

This apart, "Miss Kenya" has the indefinable feel of the Tiger Moth, with the elevator quite light and sensitive, and the rudder about right. You can almost feel the control co-ordination that should be there, but in that half-forgotten world of wind-bellied fabric and thrumming wires I was not worried by such niceties. It was sufficient to know that "Miss Kenya" remains eminently controllable from about 40 m.p.h. to the maximum of 120 m.p.h. which has so far been attempted.

I must confess that I was slightly apprehensive at the thought of getting this distinguished veteran back on the ground again, not so much because of its deceptive fragility as for the unfamiliarity of feel which it conveyed. This made an additional reluctance to end a memorable experience as I brought "Miss Kenya" downwind at circuit height, only to find that the wind had swung gently round to blow behind us on the approach. With no change in the signals square, however, I continued for landing, closing the throttle and dropping the nose until the wind sighed through the wires at about 65 m.p.h.

This was possibly slightly fast, but it was on the safe side at that operating height, and I found myself having to work fairly hard in mild turbulence as the red earth runway came slowly up to meet us. The fat Marabou storks sitting on the sun-soaked stretch of tarmac at the runway threshold barely bothered to duck as we swished very low over their heads, batting one lightly with our lower wing in the process, and then I was pudding-stirring busily in the prolonged flare-out to achieve a passable three-pointer. The tail-skid grated lightly in the murram a moment after the mainwheels touched, at some 45 m.p.h., with our nose pointed at the late afternoon sky, and then some frantic footwork on the rudder bar followed as our rudder effectiveness fell rapidly in the following wind.

I risked another circuit or two to acquire, as demanded by this splendid veteran, the temporary nicety of touch which, after a long personal period on present-day American light-planes, had become dulled and blunted. Flying the D.H. 51 was therefore as refreshing as it was salutary; it was like recovering one's sense of taste after a heavy cold, and enjoying a gourmet's meal. All credit and thanks to those concerned with the revival of "Miss Kenya"; may we continue to preserve as much as we can to remind us of our aviation heritage.

de Havilland and Redux Bonding

REDUX bonding, introduced by Dr. N. A. de Bruyne of Aero Research (now CIBA (A.R.L.), Ltd.) in 1943, has played a vital part in the design of de Havilland aircraft since the War. A link was forged between the two companies even before then, for in 1937 Sir Geoffrey de Havilland showed great interest in the plastics investigations being carried out by Aero Research and in the following year the Duxford organization undertook a research programme on behalf of de Havillands. Sir Geoffrey de Havilland, Mr. C. C. Walker and Dr. de Bruyne would then meet on Friday afternoons at Hatfield to discuss plastics in aircraft and especially sandwich structures. It may be recalled that British Patent No. 577,790 "Improvements relating to the manufacture of a light-metallic structural material or components, N. A. de Bruyne, Aero Research, Ltd., and the de Havilland Aircraft Co., Ltd." was filed in August, 1938. Post-war developments in metal honeycomb core are based largely upon this early work.*

The Hornet

The first de Havilland aircraft to incorporate Redux bonding were the Naval version of the Mosquito and the Hornet. When wartime security measures had been relaxed, a detailed description of Redux in the Hornet was published in Aero Research Technical Notes No. 39, March, 1946. In this aircraft, the development at last of a really efficient adhesive for metals in the form of Redux enabled the designers to provide a composite wood and metal wing structure using the wood in compression and the metal in tension. Metal and wood were thus bonded together to form spars of remarkably low weight and high strength and small depth, a structure that would have been impossible with wood alone. Redux was employed also for wood-to-metal bonding in the construction of the ribs and for metal-to-metal joints where local reinforcement was required.

Later that year, as a result of the successful design of the Hornet and of tests carried out by the R.A.E., Redux received M.A.P. approval and D.T.D. Specification No. 775 was issued to cover the process.

The Dove

The Dove (1946) was the first all-metal aircraft designed for bonding, and Redux was used throughout for attaching stringers in the fuselage and wings as well as for local reinforcement.

By this time a number of results had been published on comparative tests carried out with riveted, spot-welded and Redux-bonded joints. Redux had provided consistently higher failing loads and de Havilland's own full-scale tests on a Dove wing showed that panels with "top-hat" stringers bonded with Redux would reach stresses up to 125% of those developed by exactly similar panels with riveted and spot-welded joints. ("Redux Bonding in Metal Aircraft" by C. J. Moss, THE AEROPLANE, Sept. 20, 1946.)

Apart from improved strength, bonding provided the Dove with aerodynamically clean external surfaces and enabled considerable savings to be made in production costs both of Doves and Herons. In the case of the Dove, it was established that the Redux bonding of stringers to skin was approximately one-third the cost of riveting.

The Comet

From the outset it was decided to use Redux on an ambitious scale in the Comet. This aircraft, which first flew in July, 1949, would raise cruising speeds overnight by about 200 m.p.h. and much greater importance would therefore be attached to aerodynamically smooth surfaces. The high altitude flying would also pose problems of pressurization which could be solved far more easily by bonding as opposed to riveting with its need for the subsequent sealing of each hole.

Most important of all, the use of Redux enabled enormous weight saving to be achieved without detriment to strength and its principal rôle was in fact to ensure an economic payload. Full details of the use of Redux in the Comet were given by Mr. H. Povey, Director of Aircraft Production of the de Havilland Aircraft Company, in a paper on "Planning and Production Methods used in the construction of the de Havilland Comet" presented to the R.Ae.S. in April, 1951.

Today, Redux-bonded Doves, Herons and Sea Vixens continue in production. In the Comet 4, Redux is employed more extensively than before for all longitudinal stringers of the fuselage shell, spanwise stringers in wings, aileron and flap structures, wall stiffeners in fin and elevators, for the canopy structure and seams of pressure dome and in many further structural applications. Redux will also be used in the construction of the new DH121 short-haul jet airliner.

Other aircraft manufacturers now use Redux; up to the present day, more than seventy different types have incorporated these adhesives. But to the de Havilland Company belongs the credit for far-sighted confidence in this once revolutionary technique which has made possible not only new design concepts but also a new material in the form of metal honeycomb core.

* **Dr. de Bruyne writes:** I was originally approached by Mr. Hearle and Mr. C. C. Walker following an article I contributed to THE AEROPLANE on improving the creep strength of plastics. This article had caught the eye of D.H. as the company had already been investigating reinforced plastics for airscrews. I think this was in 1937; they came to my rooms at Trinity I remember. It was the beginning of a very happy collaboration with myself as consultant and it ended in 1940 when it became clear that the War was more important. Redux did *not* arise from this collaboration; this was entirely our own effort. On the other hand, honeycomb did arise very much from the work that de Havilland was doing on sandwich construction. They were using balsa wood and expanded hard rubber called "Onazote."

Aviation News in General

BLACKBURN BUCCANEER?—It is understood that the Blackburn N.A.39 for the Fleet Air Arm will be named the Buccaneer. A complete mark designation for the aircraft has not yet been announced.

S.A.C. COMPETITOR. — A B-58 Hustler from the 43rd. Bomber Wing will compete for the first time in the 1960 S.A.C. Bombing and Navigation Competition at Bergstrom A.F.B. between Sept. 13-16. R.A.F. Bomber Command is not participating in this annual U.S.A.F. competition this year.

AUSTRALIAN VISIT.—Mr. Peter Thorneycroft, the Minister of Aviation, will visit Australia in mid-September to "consult with the Australian Government in the light of the studies which have been made into the possibility of adapting Blue Streak for space research," according to an M.o.A. statement. Mr. Thorneycroft will be preceded by a party of officials led by Sir Steuart Mitchell, M.o.A. Controller of Guided Weapons and Electronics.

JORDANIAN WHIRLWINDS.—Two Westland Series 2 Whirlwinds for the Royal Jordanian Air Force were handed over on Aug. 11 at Yeovil to the Jordanian Military Air Attaché in London. Two Jordanian pilots have recently started helicopter conversion training at the company's helicopter school.

R.A.F. COMET 4s.—Negotiations for the purchase of Comet 4Cs for Transport Command are in progress. The actual number has not been announced yet but an order for five is likely. The Command's 10 Comet 2s have now logged approximately 30,000 hours.

NUCLEAR CARRIER.—The World's first nuclear-powered aircraft carrier, the U.S.S. "Enterprise," will be launched at Newport News, Virginia, on Sept. 23.

MEXICAN VAMPIRES. — The Mexican Defence Ministry has bought from an intermediate source 15 de Havilland Vampires. At least one is expected to be at Mexico City for the country's independence anniversary celebrations on Sept. 16.

PLASMAJET ROCKET.—NASA has selected the Plasmadyne Corp. for contract negotiations on a one-kilowatt electric arc rocket engine. A $200,000 12-month contract covers development of an experimentally proven arc plasmajet engine suitable for attitude control of a space vehicle; minimum thrust is to be 0.01 lb.

HUNTER RECONNAISSANCE.—First photograph of the Hunter FR.10. A developed version of the F.6 modified to mount cameras in the nose while retaining normal armament, it will eventually replace the Swift FR.5 in service with the R.A.F. in Germany.

VARIABLE-CAMBER PROP.—Hamilton Standard has received a U.S. Navy contract to develop a variable-camber propeller which promises increases of up to 30% in the range of high-speed transports. Six or eight blades will be mounted in sets of two on a common hub with the rear blades staggered behind the front ones.

19½-MILE DESCENT.—On Aug. 16 Capt. Joseph Kittinger of the U.S.A.F. made a parachute descent from a balloon between 102,800 ft. and 103,300 ft. above the New Mexico desert. He fell free for 4 min. 38 sec. before opening his parachute at 17,500 ft.; total descent time was 13 min. 8 sec. A small stabilizing parachute to prevent body spinning was tested on the descent. Records claimed for this occasion are the highest manned balloon ascent; highest ascent in an open gondola; and longest free fall.

AIR LAW COURSES.—Non-degree students and those who are not regular students may attend the courses on international and comparative air law at University College, London. There are first and second year courses (fee £6 each) with one evening lecture a week for each. Information and application forms can be obtained from the Faculty Office, University College, London, Gower St., W.C.1. Envelopes should be marked "Air Law" and the applications should be returned by Sept. 20, 1960.

MACH 2 DOPPLER.—A Marconi AD 2300 Doppler Navigator was recently flown at Mach 2 in a Mirage 4. The equipment has been undergoing comprehensive evaluation trials at the Centre d'Essais en Vol since September, 1959, when a substantial order was received from Dassault for Doppler navigation equipment and specially developed navigation computers for the Mirage 4.

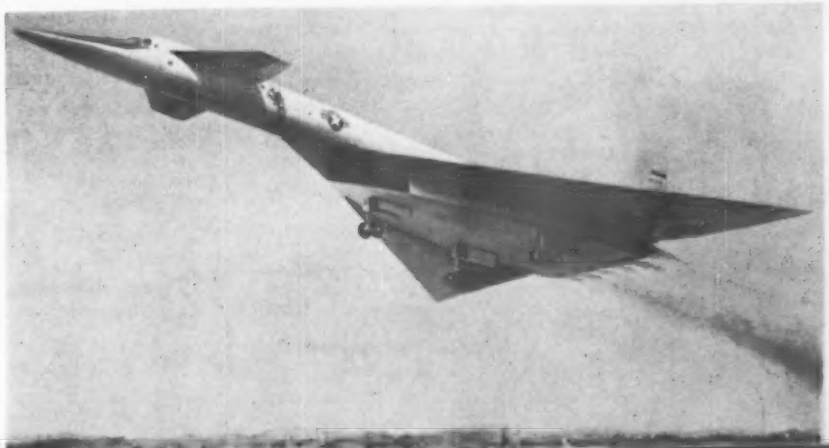
RANGE EQUIPMENT.—Ultra Electronics, Ltd., has received an M.o.A. contract to supply safety and control equipment for the Army missile range at Ty Croes in Anglesey. Earlier this year the company supplied equipment for the range at Benbecula in the Outer Hebrides.

INDIAN TEST PLANT.—Heenan and Froude, Ltd., of Worcester are to supply Hindustan Aircraft, Ltd., of Bangalore, with plant for the post-overhaul testing of Rolls-Royce Dart turboprops.

RALLYE NEWS.—In addition to the 150 French orders for the M.S.880 Rallye, reported in our issue of Aug. 12, the manufacturers report a further 19 from Norway, 11 from Germany, two from Australia, two from the U.K. and one from Brazil. The *Grand Tourisme* version is to be abandoned in favour of the Super Rallye, with a 145 b.h.p. Continental, and the Rallye Club will be offered with the 90 or 100 b.h.p. Continental. The Super Rallye will cost less than £2,500 in France, including 20-channel VHF.

SPACE COURSE.—The College of Aeronautics, Cranfield, is beginning its first one-year post-graduate course in space technology on Oct. 10. Students who complete the course will be awarded the Diploma of Advanced Engineering (D.A.E.). Information about the course can be obtained from the Warden of the College at Bletchley, Bucks.

AERONAUTICAL CONGRESS.—The 2nd International Congress of the Aeronautical Sciences will be held in Zurich between Sept. 12 and 16.



B-70 AERODYNAMICS. — Additional funds have been voted for development of the Mach-3 B-70 bomber. This artist's impression shows the engine arrangement which is designed to improve the cruise lift/drag ratio by interaction between the nacelle shock-wave and the under surface of the wing.

Commercial Aviation Affairs

MORE DC-8s FOR ALITALIA.—Two more DC-8s have been ordered by Alitalia, bringing the total to eight. Three are already in service, a fourth is due in September and the remainder will be delivered in 1961. Alitalia is also expected to order four more Caravelles; eight have so far been ordered and four have been delivered.

E.A.A. COMET FLIGHT.—East African Airways' first proving flight with a Comet 4 was due to leave London Airport on Aug. 22, with an E.A.A. crew and B.O.A.C. supervisory crew. It is scheduled to be delivered in Nairobi on Aug. 30, and will be followed by the second Comet 4 early in September.

HELICOPTER SUSPENSION.—Pending the assurance of a Government subsidy, or funds from industrial organizations, Elipadana has suspended its helicopter services from Milan to Turin and Lugano.

FACILITY CHARGES.—As a step towards the adoption of a policy of full recovery of costs from users of airport and airway facilities, the Australian Air Navigation Charges Act is to be amended to increase the amounts payable by the airlines. Additional revenue is estimated at £A450,000 for the full year 1961-62.

KLM LINK DISCUSSED.—Reports from Amsterdam last week that KLM was considering some form of closer collaboration with other European airlines have been confirmed by a KLM spokesman. A link with Swissair and SAS is thought to be most likely and a decision is expected before the end of the year.

TURKISH DELIVERY. — Fairchild has recently delivered three F-27s to the Turkish airline THY, and two more will be delivered next year. THY is also to receive five F-27s from Fokker in the near future.

T.A.I. DC-8 PLANS.—There will be two main stages in the Transport Aériens Intercontinentaux plans for a round-the-World service with DC-8s. From Sept. 12 turbojet operations will be over the Paris-Sydney-Noumea run, with DC-7s making the return Noumea-Tahiti-Los Angeles flight and Air France 707s completing the circuit via Montreal to Paris. From May 1, 1961, T.A.I.'s DC-8s will complete the round trip with two aircraft leaving Paris for Tahiti in opposite directions. The T.A.I. DC-8s will necessarily carry the Air France flag over the Paris-Montreal-Los Angeles legs.

THE ROME NEAR-MISS.—A statement issued by the Italian Defence Ministry last week said that the P.A.A. Boeing 707 with which a B.E.A. Viscount nearly collided "had arbitrarily and excessively approached in the corridor reserved for instrumental landings." The circumstances were fully described in our previous issue.

SELLING DC-4s.—Pan American is offering seven DC-4s (including one freighter) which have been used in Germany, for £21,000 each at Frankfurt. One has been bought by the Swiss Balair; the others may be taken to Miami for storage if they cannot be sold. Lowest quotation for a DC-4 in the current Aircraft Exchange Market Report is $190,000 (over £68,000).

KLM TO GHANA.—An air agreement has been signed between Holland and Ghana, as a result of which KLM will inaugurate a twice-weekly service to Accra in November, using Super Constellations and, later, Electras. On Nov. 5, KLM will also inaugurate a weekly Electra service to Conakry and Monrovia.

DC-7 SUPERSEDED. — American Airlines is about to withdraw its DC-7s from non-stop transcontinental service after seven years. The 18 passenger-carrying DC-7s remaining with American will be used to upgrade service on other major routes; the company also uses 15 as all-freight carriers and has traded-in another 25 for its forthcoming fleet of Convair 990s (American Airlines' name for the Convair 600).

QUICKER BY BUS.—Traffic congestion on the approach road to London Airport Central is now so bad during peak departure times (08.00-12.00 hrs. and 17.30-20.00 hrs.) that B.E.A. recommends its passengers to use the airport coach from the West London Air Terminal rather than their own cars.

EXPORT PROMOTION.—In conjunction with Air Safaris, Overseas Flying Exhibitions, of Gatwick Airport, is starting a series of airborne exhibitions for Europe in October. The aim is to improve exports—particularly among small manufacturers.

CHEAPER STILL.—Our inadvertent use of a "£" sign when "$" was intended, gave the impression that the Link Simulette (described in our previous issue, p. 212) is more expensive than it really is. The approximate price is expected to be $225,000.

THOUSAND HOURS.—A General Electric T58-6 turboshaft has powered this U.S. Navy HSS-1F helicopter for 1,000 hours without overhaul; during this time the helicopter was flown on a single T58. This turboshaft is built under licence in England as the de Havilland Gnome.

News About People

AFRICAN ADVISER.—Sir Duncan Cumming, K.B.E., C.B., has taken up a part-time appointment with B.O.A.C. as adviser on African affairs. He has been associated with the Corporation for six years and is on the board of B.O.A.C. Associated Companies.

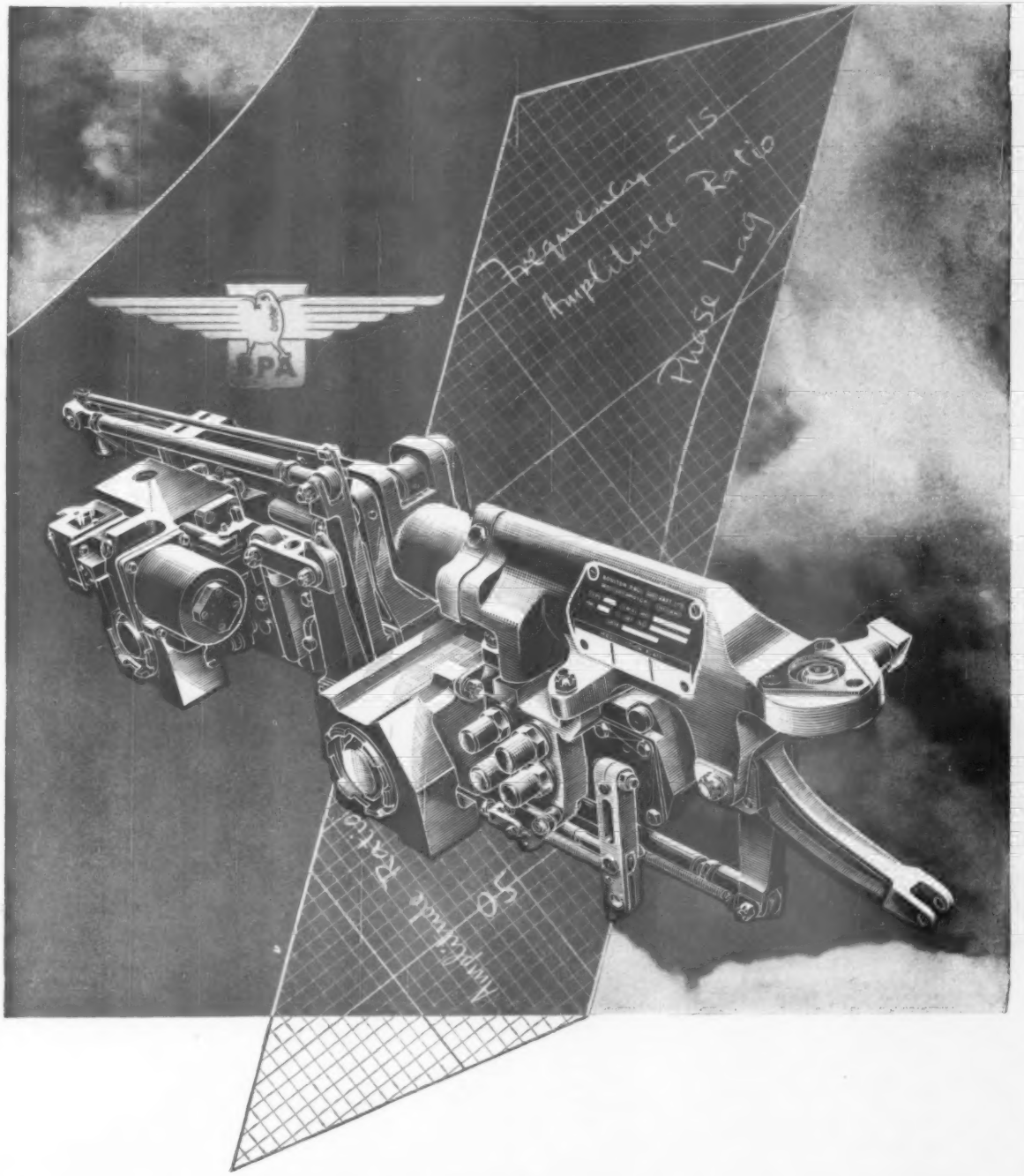
ROLLS-ROYCE APPOINTMENTS.—Mr. R. M. Kendall, who has been general manager of Rolls-Royce of Canada, Ltd., for the past seven years, is returning to England. He has been appointed general manager, sales and service, for the aero division of Rolls-Royce, Ltd. He will be succeeded at Rolls-Royce of Canada by Mr. James Wood, who has been appointed vice-president and general manager, effective Sept. 1, 1960. With effect from the same date, Mr. David Boyd has been appointed vice-president and deputy general manager, and Mr. A. P. Smibert, who was recently made financial and commercial manager, has been appointed vice-president and secretary-treasurer.

SALES AND SERVICE.—As recorded here, Mr. R. M. Kendall has been appointed general manager, sales and service, for the aero division of Rolls-Royce.

TRANSPORT AWARD.—The Institute of Transport's Bristol and White-Smith Air Transport Student Prize for 1959-60 has been awarded to Mr. A. P. Fleming, B.O.A.C. traffic superintendent, Southern routes.

COSSOR DIRECTOR.—Mr. G. G. Roberts has been appointed technical director of Cossor Radar and Electronics, Ltd. He was previously on the board of the Aviation Division of S. Smith and Sons (England), Ltd., and before that in the R.A.E. Guided Weapons Department.

ELECTRONICS APPOINTMENT.—Mr. C. J. Francis has been appointed Counsellor (Defence Research and Supply), Ministry of Aviation, Canada, in succession to Mr. F. S. Barton, C.B.E., who is retiring.



POWER CONTROLS

Rotary control valves incorporated in Boulton Paul powered flying control units ensure sensitivity and accurate response when operating in manual control or under autostabilizer and auto-pilot authority. Duplication of the NA.39 rudder unit shown in the illustration is achieved by using a tandem ram operated by separate hydraulic supplies to the two sides.

BOULTON PAUL AIRCRAFT LTD.
WOLVERHAMPTON, ENGLAND

P.C.24

New Freighter from Belfast

TWO prototypes of the Short SC.7 Skyvan are now being built at Belfast and the first flight of this new freighter is expected before the middle of next year. According to the company, this aircraft "carries 1½ tons of almost anything and operates safely at full load from any half-mile field, clearing or strip." It will carry this 1½-ton payload over 200 miles at 160 m.p.h., or a 1-ton payload for 900 miles at 140 m.p.h.

Designed primarily as a light freighter, the Skyvan is a twin-engined all-metal monoplane with strut-braced high wing. It has a twin-finned tail unit and a fixed tricycle undercarriage and is powered by two 290-h.p. Continental GTS IO-520 six-cylinder supercharged and geared piston engines with direct fuel injection. They drive three-bladed constant-speed fully feathering Hartzell propellers.

The fuselage is approximately square in cross-section and provides a volume 16 ft. long, 6 ft. 6 in. high and 6 ft. 6 in. wide. The large rear-loading door can be opened in flight for air dropping.

Capacity payload is 3,000 lb. (15 passengers) and the maximum fuel capacity is 150 Imp. gallons. Design all-up weight is 8,600 lb. but the structure is stressed to 9,000 lb. British Civil Airworthiness Requirements will be met at all weights up to 9,850 lb. in I.S.A. conditions.

Although designed as a light freighter, the SC.7 is suitable for a wide range of civil and military rôles. Its maximum payload can be carried at density down to only 5 lb/cu. ft. The large rear loading door is opened and closed manually.

Freight is loaded through the rear door; the fuselage floor is only 2 ft. 2 in. above ground level. The floor is made up of removable stiff panels with combined lashing and seat location points.

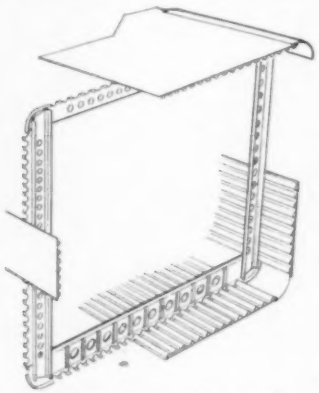
If a load is so large that it cannot be lashed down from inside the aircraft, the lashing points can be reached through doors at floor level in the fuselage side. Built-in levelling jacks under the rear sill of the fuselage steady the aircraft during loading. With the use of spreaders, floor loadings up to 750 lb. per wheel are acceptable when vehicles are carried.

Civil rôles for the Skyvan, in addition to freighting, include use of the aircraft as a passenger, executive or vehicle transport; as a flying showroom; and for agricultural duties. As a passenger transport 15 people can be carried in seats pitched 38 in. apart; lightweight triple seats can be installed, or one row of doubles and one of singles. In addition, part of the space over the rear loading door can be used to install a toilet and galley facilities.

The Skyvan is suitable for a wide range of agricultural duties. More than a ton of wet or dry chemicals can be carried in addition to their hopper. Its good handling qualities down to 70 m.p.h. are a big asset for agricultural duties.

Military rôles include use of the aircraft for supply dropping, paratrooping, and as a troop transport or ambulance. Using a roller conveyor and extractor parachute system, palleted loads totalling about 2,800 lb. can be dropped. The rear door allows loads up to 5 ft. high on the pallet to be dropped.

Twelve fully armed paratroops can be carried and air dropped. Up to 15 seated troops can be flown over a still-air range of about 200 miles. As an air ambulance up to 12 stretcher cases and an attendant can be carried.

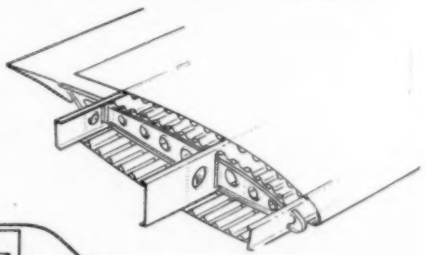


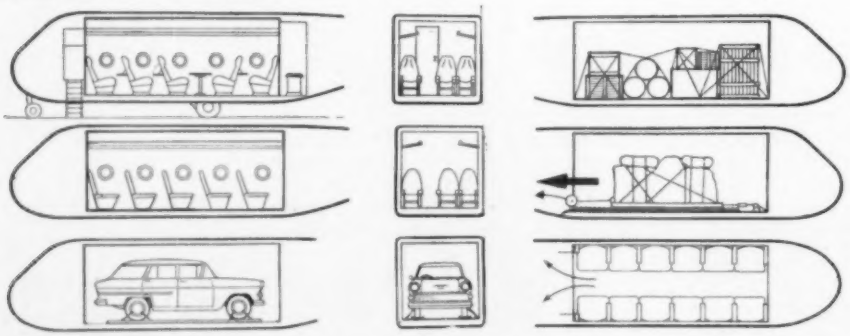
STRUCTURE.—Skyvan skinning is of the sandwich type; a flat outer sheet is Redux-bonded to a corrugated inner one.

Flight Deck

The Skyvan flight deck is designed for one-man operation, but there is a second crew seat and provision for dual control. There are entry doors on both sides of the fuselage.

Sufficient navigation and communication equipment is provided as standard to fly airways in instrument meteorological





VARIED ROLES.—Internal layouts of the Skyvan can be varied for a range of civil and military rôles. It will carry 15 passengers or troops, freight or vehicles. Twelve fully equipped paratroops or palleted loads of supplies can be air dropped (left).

conditions in all parts of the World. Two alternative installations are offered.

One is for operations in the U.S.A. and Europe, where VHF communications and primarily VOR navigation are in use, the other for the areas where HF communications and ADF navigation tend to be the rule.

Additional equipment which can be installed to special order includes an automatic pilot and weather radar.

Structure

The SC.7 has a non-buckling stressed skin structure. Almost the entire aircraft has a sandwich skin made of an inner corrugated sheet which is Redux-bonded to an outer skin. The panels are bonded in very large units; for example, a wing skin is a single unit from root to tip. The corrugated inner skin is in unbroken strips from root to tip, each about 15 in wide and containing four corrugations. The outer flat skin is unbroken from the leading edge to the trailing edge but changes gauge along the span.

Basically, the aircraft has been designed on the "safe-life" philosophy, with fail-safe features. In the fatigue-prone parts of the structure, low tensile strength aluminium alloys have been chosen in view of their better fatigue properties. To combat corrosion all components are anodized and normally unseen areas as well as the outside of the aircraft are painted.

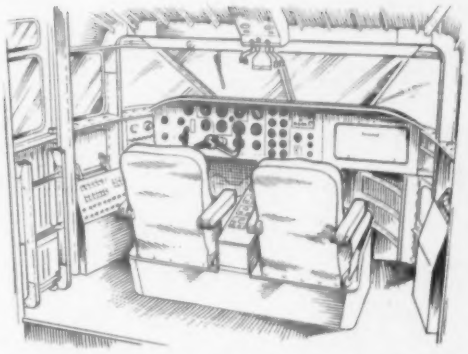
The wing geometry is based on a careful optimization study involving the span, area, taper, section, weight and general configuration. It has parallel chord and an aspect ratio of just over 11. Its laminar-flow aerofoil section is 14% thick, and has a design lift coefficient of 0.6.

The trailing edge of the wing is made up of six identical single slotted flaps, the outer pair of which have geared tabs and act as ailerons. These droop through half the angular movement of the four inboard flaps.

The tailplane is a single cantilever component attached to the top of the rear fuselage by four bolts. Two fins are bolted on to the ends of the tailplane; only the elevator balances extend outboard of the fins. Elevators have geared tabs.

Systems

Flying controls are conventional; their circuits are operated partly by cables and partly by push-pull rods. The pilot's hand-wheel, which operates ailerons and elevators, pushes straight in and out of the dashboard. The rudder pedals are of the hanging type with toe brakes. Light, self-centring forces and a large amount of trim are provided on all three axes by means of rubber blocks in torsion. No trim tabs are fitted.



FLIGHT DECK.—The Skyvan is designed for operation by a single pilot, but there is a second seat on the flight deck and provision for dual control.

A 28-volt D.C. split-busbar electrical system is used. Each busbar is fed by one engine-driven generator and one battery. The small quantity of A.C. needed is obtained from transistorised inverters. Conventional flashing navigation lights are fitted, together with two landing lights in the nose. All instrument panels are lit by reflection screens.

The fuel system has a single 150-gallon glass-cloth fuel tank mounted in the wing above and outside the fuselage. Two booster pumps feed the engines via a fuel-injection system.

Cool, warm or hot air is supplied to the flight deck floor and the base of the windscreen. Ram air is taken in at the nose and all or part is passed through a simple combustion heater.

A liquid de-icing system is used for the leading edges of wing and tail unit. Sufficient fluid is carried for two hours' operation at maximum flow. There are slinger rings at the root of the propeller blades and the windscreen is fitted with wipers and a liquid spray to remove ice and frost.

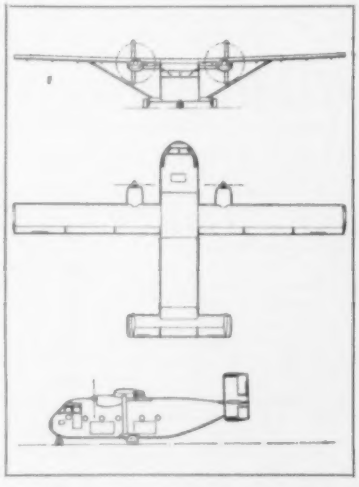
Two fire-extinguisher bottles are installed in each engine bay with a detection and warning system. They are operated by the pilot or by the inertia crash switches.

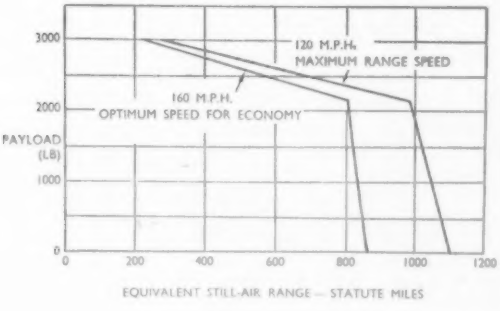
Technical Data

DIMENSIONS.—Wing span, 64 ft. 1 in.; overall length, 38 ft. 11 in.; overall height, 13 ft. 10.3 in.; wing area, 373 sq. ft.; wing aerofoil section, NACA 634-614; gross internal volume of fuselage, 1,195 cu. ft.; main hold volume, 680 cu. ft.; main hold floor area, 104 sq. ft.

POWERPLANT.—Two Continental GTS IO-520 piston engines, 390 h.p. each at take-off.

WEIGHTS.—Structure, 2,697 lb.; powerplant, 1,455 lb.; fuel and oil supply, 108 lb.; airframe and equipment services, 378 lb.; airframe equipment, 318 lb.; furnishings, 671 lb.; operators service items, 307 lb.; weight less fuel and payload, 5,330 lb.; fuel and payload, 3,270 lb. all-up weight, 8,600 lb.





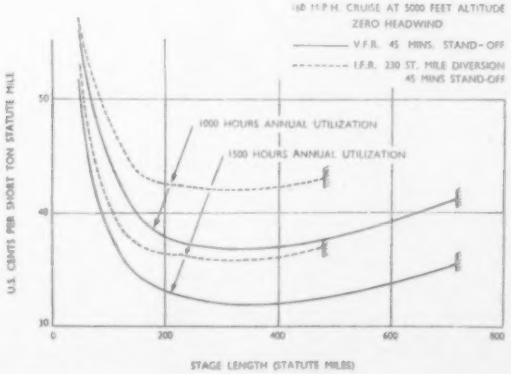
RANGE AND PAYLOAD.—This range/payload graph for the Skyvan is based on operation in I.S.A. conditions.

PERFORMANCE.—Take-off distance to 35 ft.: I.S.A. at sea level, 413 yd.; I.S.A. +30° C. at 5,000 ft., 577 yd. Balanced field length (unfactored), I.S.A. at sea level, 776 yd.; I.S.A. +30° C. at 5,000 ft., 1,066 yd. Landing distance from 30 ft.: I.S.A. at sea level, 470 yd.; I.S.A.+30° C. at 5,000 ft., 577 yd.

Rate of climb at 8,600 lb. weight, I.S.A. at sea level: 1,410 ft./min. on two engines, 325 ft./min. on one engine. Rate of climb at 8,600 lb. weight, I.S.A. +30° C. at 5,000 ft.; 1,250 ft./min. on two engines, 188 ft./min. on one engine.

Range with average airline allowances and 3,000 lb. capacity payload: 115 miles in IMC, 70 miles in VMC. Full-tanks range at 8,600 lb. with 2,200 lb. payload: 710 miles in VMC, 500 miles in IMC.

Speeds, E.A.S.: stalling, flaps down, 62 m.p.h.; stalling, flaps up, 75 m.p.h.; take-off safety, 82 m.p.h.; en-route climb, 109 m.p.h.; cruise, 166 m.p.h.; design diving, 236 m.p.h.; target threshold, 87 m.p.h.; touchdown, 68 m.p.h.



COSTS.—Direct operating costs for the Skyvan by the A.T.A. method show a minimum of 32 U.S. cents per short ton statute mile for stage lengths between 300 and 400 miles.

Personal Flying

PRESAGED PROSPECTOR.—A newcomer to Farnborough this year will be the Cheetah-powered L.A.C. Prospector II, which was anticipated by this Kingsford-Smith Aviation Services modification in Australia. The 400 b.h.p. Cheetah Xs are Airspeed Oxford powerplants.

TWENTY-SIX aircraft arrived within thirty-six minutes for the London School of Flying Tea-Patrol on Sunday, Aug. 14; there were, however, 17 aircraft defending their base, and only five of the invaders got through undetected. They were Mr. Nicholls from Biggin Hill, Mr. O'Cleary from Baginton, Mr. Last from Filthorpe, Mr. Spiller from Sywell and Mr. Bennett from Stapleford. There was also a sealed landing-time competition at Elstree, won by Mr. Ringer.

Techniques of approach varied; there was even a contingent of the Tiger Club who arrived in close formation. Most of the successful contenders adopted a shallow dive.

• • •

● The **Norfolk and Norwich Aero Club** at Swanton Morley now has 35 student pilots, 10 of whom have flown solo, and has its Kranich sailplane back in operation after a C. of A. It has a Tiger Moth for both flying instruction and aero-towing.

● Despite a very wet summer, the **Oxford Aeroplane Club** completed more hours in July than in any previous month. Credit for this is given to the new Tri-Pacers, which can be flown in worse weather conditions than were previously acceptable. The Club's Miles Monarch is still popular for touring, however, and was taken by two members to the Deauville Rally. After much hard work, Pat Sullivan has gained his C.P.L., and Eddie Portman and Tony Savile, their P.P.L.s (on Tri-Pacers). First solos were made by Messrs Pennington, Cherry and Wilkins.

● July solos at the **Surrey and Kent Flying Club**, Biggin Hill, were made by Cdt. Cpl. R. A. Holness, Cdt. A. Kelvin and Mr. J. L. Greenlees. One of the club members, Mr. H. W. Preiskel, recently flew the Prentice G-AOLR to Israel. The club annual dinner and dance is to be held at the Greyhound Hotel, Croydon, on Friday, Oct. 28.

● There has been a further increase in activity at the **Edinburgh Flying Club,** which flew a total of 83 hr. in July. The sole remaining Tiger Moth has now been sold, and with the new radio-equipped aircraft, students are not allowed to go solo at Turnhouse without an RT licence.

• • •

Following the very useful booklets on British and foreign aircraft types available for private and executive use, W. S. Shackleton, Ltd., has now introduced a brochure setting out the basic information on business aviation for commercial organizations. Attractively produced, "Your Own Aircraft . . ." deals generally and briefly with such aspects as the selection of individual types, ease of purchase, speed, reliability, safety, convenience, costs and comfort, and is obtainable from W. S. Shackleton, Ltd., at 175 Piccadilly, London, W.1.

Gliding Notes

by Dr. A. E. Slater

ELECTRIC shocks of unusual intensity were suffered by Humphry Dimock inside a thunder cloud which he entered 10 miles west of Odiham on Jly. 22 during the R.A.F. Championships. With him in his Eagle was "Nobby" Clarke, the only Royal Marine in the R.N. Gliding and Soaring Association.

Dimock writes: "The blue flashes in the cockpit travelled through my rubber shoes and rubber grip on the joystick and were so intense that I cried out aloud with pain every time I put my hand near the joystick, and I was forced to steer a straight course out of it at 9,500 ft."

He was in another cu-nim near Lasham on Aug. 2 with his son as passenger, at 16,500 ft. and going up fast, when unfortunately his son was air-sick and had to discard his oxygen mask. A similar frustration on a two-seater height record attempt befell Jock Forbes in California in 1951; he had reached 26,000 ft. in the Bishop Wave when his passenger, a 16-year-old boy, was taken ill and he had to hurry down again.

Electricity attacked Mike J. Smith of the Coventry Club in his Olympia when he was going up fast at 16,000 ft. in a thunderstorm over Edgehill, on Aug. 7. Lightning flashed and he felt a nasty shock in both hands, the one on the stick and the one on the airbrake handle, so he broke off the climb and straightened up, though, as this didn't bring him into clear air, he circled in the first down-current he came to and emerged from its base. After landing, he found not only a hole burnt in the side of the cockpit but a tear in the rudder fabric, under which the wood had a shredded appearance suggesting a lightning strike.

Mike Smith is a student at Birmingham University, and if only the University had a gliding club, this flight, which gave a height gain of 14,200 ft., might have earned him the Brunt Trophy, which hitherto has always gone to Cambridge.

• •

CARLTON MOOR, the Newcastle Gliding Club's new site, is 43 miles from Newcastle, but only 13 air miles from the Yorkshire Gliding Club. So a visit to Yorkshire in National Gliding Week gave an opportunity to see it for the first time, the road distance being 22 miles. You take a main road northwards from Rievaulx Abbey, turn left at a hamlet called Chopgate, and later turn left up a steep home-made track.

Just below a 1,338-ft. summit is a long hut, brought in sections from the Club's previous site at Usworth and fitted out as a clubhouse at one end and a hangar at the other. A week's camp was in progress and, Dr. Leslie Kiloh explained, was being devoted equally to work and flying.

The site is an extensive black moor—black because of a fire last year which, at least, has exposed a lot of hidden boulders which are being duly removed before the heather can hide them again. Two runways, already in use, are about the length of the 2,700-ft. launching cable and a third is being made.

The club owns a Cadet, Tutor, Olympia and T-21, and there are eight privately owned machines plus a two-seater Bergfalke which is on the way. Ken Saddington, who owns the land and had ambitions to start a gliding club before the Newcastle people discovered him, has granted the club a long lease.

Here, at the northern end of the Cleveland Hills, the slopes face generally N.N.W. (as at Nympsfield), but in addition a steep W.N.W. slope falls away from the very edge of the club ground on one side and an east slope on the other, while the enormous bowl at Ingleby Greenhow, a favourite soaring site nearly 30 years ago, is 4 miles away.

• • •

NOW that Philip Wills has added a third Diamond to his Gold "C" badge by flying 500 kilometres in Texas, can anyone say how many previous attempts he has made, and in how many European countries?

So far as he has related them in *Sailplane & Gliding*, Philip Wills' attempts on the 500 km. (311 miles) have been: Jne. 11, 1957, missed it by 22 miles in France. Jne. 23, same year, missed in England by 31 miles on a three-legged course, Lasham-Firle-Tarrant Rushton-Wadebridge.

Next, two in Poland at the 1958 World Championships: he missed it by nine miles on the last practice day, Jne. 14, and by 17 miles on Jne. 25 on a flight to the Russian frontier, which would have had to be crossed to make it. Then a miss by 14 miles on May 24 last year in a flight from Holland across Belgium into France in cloudless weather.

The successful flight was 332 miles (534.3 km.) on a three-legged course from Odessa in Texas 77 miles W.S.W. to Pecos, back to Odessa, and then 178 miles E.N.E. to Haskell.

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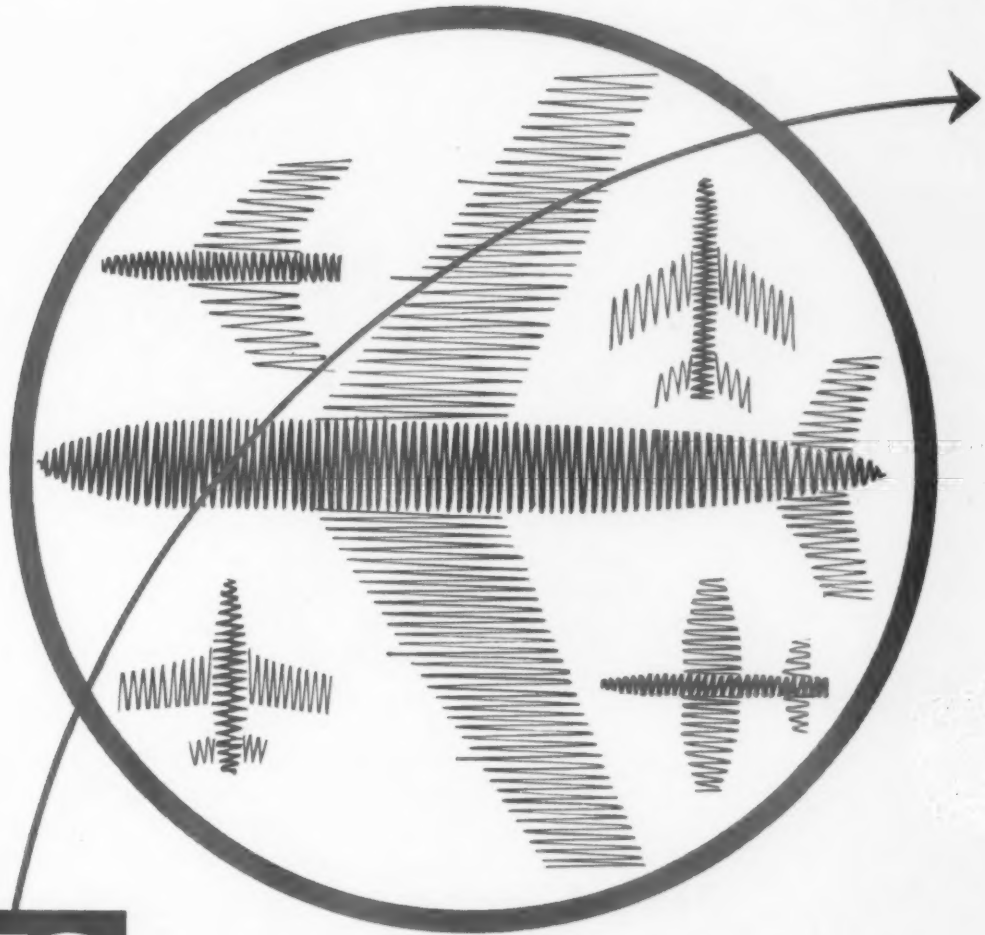

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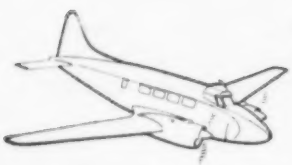

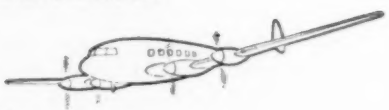

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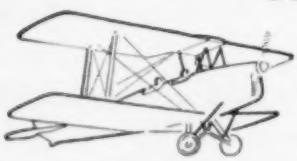

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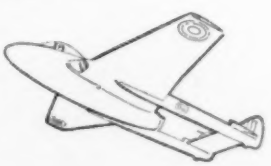


Correspondence

Honest Broker

RECENT mention (Aug. 5) of the two Fokker F-22s and the one F-36 at Prestwick during the War reminds me of a saga which has not been told.

Just before the outbreak of the 1939/1945 War, David McIntyre (with the Duke of Hamilton, co-founder of Prestwick Airport and co-conqueror of Everest) outlined to me his plans to acquire these aircraft and to convert them to navigation trainers. He asked me to examine them and, if satisfied, to buy them from K.L.M. I went over to Schiphol with Spry Leverton, K.L.M.'s London manager. I was in little doubt as to their condition. As one would expect, they were superb aeroplanes. Soon afterwards McIntyre and I went over to see Dr. Plesman and Chief Engineer Veenendaal. Final details about spares and maintenance equipment were settled. We arranged to return to Holland when one or two details had been attended to.

Europe was on the brink of war. There was dirty work at the crossroads. Champagne salesman "Ribbontripe" was having friendly talks with Stalin. That night I could not sleep at all but—thank God—I had a hunch!

I remembered that at the time of Munich the Netherlands Government had put a "freeze" on all aircraft in Holland. What if they did that again tomorrow when McIntyre and I were due to go over to arrange for their delivery to the U.K.? Finally I decided to phone McIntyre and got him out of bed at 3 a.m. After due apologies I urged that the purchase price in cash should be cabled to K.L.M. directly the banks opened. He agreed immediately. He didn't yawn or tell me what to do with the aeroplanes. He was the unflappable McIntyre—the man we all knew and liked so much.

In Holland at 3 p.m. that day the "freeze" was on. No Dutch aircraft could be sold, change hands or leave the country. At about that time Plesman was explaining to officials at The Hague that the aeroplanes were no longer his. They belonged to an obscure broker named Shackleton. An honest broker—perhaps—but a broker!

At 6 p.m. that day both the F-22 and the F-36 were at Croydon. Later I bought the remaining F-22, which was already on the British Register, for Scottish Aviation from Rolly Falk's company, British American Air Services.

London, W.1. W. S. SHACKLETON.

Adding Insult to Injury

YOUR article on Jly. 1 last high-lighted the passenger traffic problem which London Airport, Northside Terminal, is currently seeing due, primarily, to the tremendous increase in passenger travel across the North Atlantic route.

As an Englishman I must say I was thoroughly embarrassed during my recent return visit to England to notice the contrast between the terminals in the two major cities of the World, that is, London and New York. Such a condition as currently exists in London Airport, Northside Terminal, must have been foreseen and, there is, in my opinion, no excuse for such poor facilities. To charge 7s. 6d. for the "honour" of using these facilities is, in my opinion, adding insult to injury.

Denville, New Jersey, U.S.A. DERYCK W. CHILDS.

The Jet Fuel Controversy

AS Mr. Rickard correctly points out (Aug. 5) JP-4 grade fuel has most of the vices in respect to fire risks both in flight and on crash landing compared to kerosene. He ends by saying that "the main advantage of kerosene lies of course in its low rate of flame spread following crash spillage and subsequent ignition." Agreed. There is also another "main" advantage, namely that kerosene inherently is less likely to catch fire at all.

London, S.W.3. J. C. D. SOLTZ.

Polish Sailplane Details

HAVING read with a great interest the article "New Sailplanes at Butzweiler, 1960" (Jly. 22), I should like to put your contributor, Mr. Peter W. Brooks, right on several points concerning the construction of the Polish SZD-19-2 "Zefir 2" sailplane.

Save the similarity in shape the Zefir 2 has very little in common with the experimental prototype Zefir 1, the description of which has been quoted in the article as that for Zefir 2. From constructional point of view the Zefir 2 is entirely different from its predecessor, having the basic structure rather similar to that of the SZD-24 Foka standard-class sailplane.

Its laminar-flow wing is a torsion-box ply-and-foam sandwich structure with ply-and-foam sandwich D leading-edge. Thirty-five per cent. three-section Czech-type flaps, built as stressed-skin ply-and-foam sandwich structures and wooden one-piece upper-hinged plain SZD-type ailerons, covered with fabric, are fitted. The fuselage is a wooden monocoque covered with plywood skin, except for the nose-section, which is externally and internally covered with glass fibre.

The laminar-flow fin, a ply-and-foam sandwich, is built integral with the fuselage. The tailplane is of similar structure, but the moving surfaces are wooden-frame structures covered with fabric.

With complete revision of the Polish glider production programme, resulting in termination of Jaskolka manufacture, both the Zefir and the Foka are about to enter quantity production, though the Zefir will be built in fewer numbers.

London, N.9. J. B. CYNK.

Groundabout

Homo Sap. Things, after all, *are* pretty much what they used to be. I've just read, for the first time, the World War I classic "Sagittarius Rising" in which pilot-author Cecil Lewis describes the fearful, week-long Allied bombardment, which preceded the 1916 Somme attack, as "the most effective way of destroying wealth" (meaning the materials, capital, labour and know-how put into shell making and firing) "that man has yet devised." This seemed to strike a chord—then I remembered a recent American statement that in the last 37 months 55 Atlas missiles had been fired. Press a button today and more "wealth" is destroyed in a few minutes than they could manage in a week in 1916. Mind you, we learn something from it, they say—and nobody's been hurt. So far.

*

Counting Down the Cost. Chapman Pincher, *Daily Express* science correspondent, flaying the politicians' failure to back our scientists and engineers in the space race, turns some splendid, bitter phrases like "... a Government too down-at-heel in spirit to afford them opportunity." But the best seems to me to sum up this Treasury-cursed age. Unless the Government changes its "it-must-be-economic" mind, he writes, historians will say of our generation that "when opportunity knocked all we did was to complain of the noise."

*

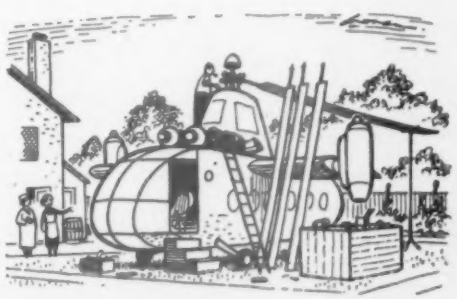
Petition from the Deafened Ones

"My lord,
We hope the Trident
Won't be strident."

*

Captain Juliet. If the near-collision between a Viscount and a 707 can have a lighter side, it is in the Italian newspaper reports of the grim incident. The near miss occurred over the Rome beacon Lima Juliet, and the frequent references to this positioning-aid were too much for the Roman reporters, who decided that the name of the Viscount pilot was Captain L. J. Beacon.

*



"When he retired from the board after the take-over, he felt he had to do *something* ...."

by Gross

Aircraft Equipment by Ferranti

A HELICOPTER flight-instrument system and a stable platform for inertial navigation are the latest developments of the Ferranti aircraft equipment department. These projects are still being developed, but the department has in production a wide range of gyro equipment for aircraft and a series of fully transistorized power units. The department's development base is at Bracknell, in Berkshire, and its factory at Moston, Manchester.

Ferranti, Ltd., is one of the largest private companies in Britain. Its activities are divided among a range of departments, each of which is virtually autonomous.

Not all Ferranti aeronautical equipment is produced by the aircraft equipment department. A notable exception is the Airpass navigation and fire-control radar system, which is produced by a department at Edinburgh. Other examples are the company's contribution to the Bloodhound missile system, its Apollo computer for air traffic control, and the digital computers supplied to aircraft companies.

Background to the Story

During the War Ferranti produced aircraft instruments for the Ministry of Aircraft Production, but little original work was done before the development of the gyro gun-sight at Moston. This was produced at Edinburgh and after the War it was logical for the establishment there to follow this with the development of airborne fire-control systems, as exemplified by Airpass.

In 1948 the Ministry of Supply asked Ferranti to develop an artificial horizon; a new and more accurate instrument was needed for high-speed aircraft and, in addition, it was considered a good idea for a new company to be brought into this field of design and construction. As a result the company developed the 4½-in.-diameter Mk. 4 artificial horizon, which has been standardized by the R.A.F. and Royal Navy for all its later aircraft. A range of other instruments has also been developed; these are based on the same gyro unit. An extensive series of artificial horizons, bomb-sight gyros and vertical signalling gyros have been produced.

The company's next major move in this field was the development of a 3¼-in.-diameter artificial horizon to be used as a standby instrument. Ferranti won the design competition for this instrument, which is an entirely new unit and not a scaled-down version of the 4½-in. design. This standby artificial horizon is now standard equipment for military aircraft and has also been adopted for many civil aircraft, including the Comet, the B.O.A.C. Boeing 707, the Vanguard and Argosy. The company also produces transistorized standby inverters, control-inverters or control units for these instruments.

By the mid-1950s Ferranti work on aircraft gyros was becoming a substantial business and the company decided to set up a separate department to deal with it. Thus in 1954 the aircraft equipment department was formed.

At this time it was decided that the design and development facilities of the department should be expanded. As a result the department opened a new research, design and technical service establishment at Bracknell and all its new development work is now done there, although Moston remains responsible for production. At present the department has about 550 people in all, of which some 115 are at Bracknell.

The next development was the standby directional gyro, using the same basic unit as the 3¼-in. artificial horizon. This has been adopted by the R.A.F. and Royal Navy as a heading standby, and is installed with the standby artificial horizon.

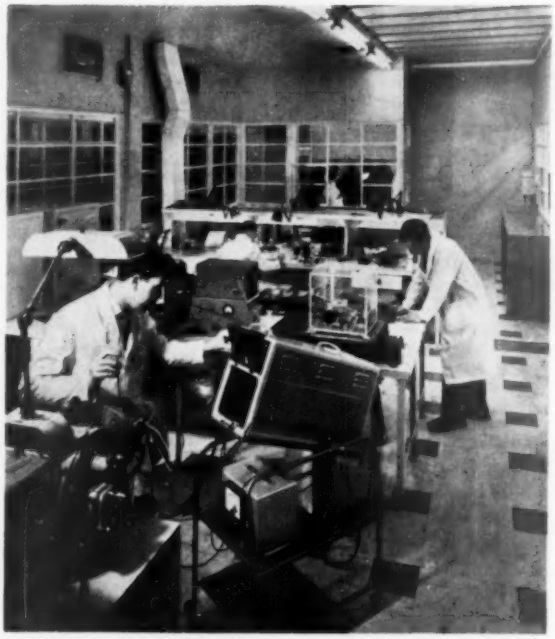
The build-up of a development team at Bracknell came at a difficult time, as it coincided with cutbacks in the industry. One of the first tasks undertaken was the design study of a stable platform for a survey camera in the Avro supersonic bomber. Accurate vertical stabilization was needed. This project was cancelled following the demise of the bomber.

The department has aimed to widen its activities and lessen its vulnerability to changes in Government policy. An example of its work in a new field is the development of transformer-rectifier units for the Vickers Vanguard; these represent its first break into the static-power electrical field. The department is also developing similar units for the Vickers VC 10.

Another example of diversification is the department's production under licence of Kearfott single-axis accelerometers and development of high-efficiency transistor automatic voltage regulators used for missile guidance and for stable platforms.

An increasing amount of civil business is now being handled by the department. Its technical-services section at Bracknell is responsible for technical publications as well as for doing all it can to back up instruments in service. The department gives a 24-hour service to airline operators at London Airport.

At Bracknell development work at present is devoted to a stable platform and a helicopter instrument system. In parallel with the earlier work for the Avro bomber, the Ministry foresaw a need for an inertial stable platform for aircraft. In addition, about 2½ years ago a design study was made of an inertial platform for supersonic aircraft; its requirements were then altered to those of the current system. Several prototypes have already been built. Ferranti claim that it is the only inertial system for aircraft now under development in Britain.



ACCELEROMETER TESTS.—A Kearfott single-axis accelerometer built under licence by Ferranti is seen here under test at the company's Moston factory.

Known as the type 100, this stable platform is of intermediate size compared with the miniature platforms developed in the U.S. A special feature is the large azimuth gyro which allows accurate heading information to be obtained for some hours without monitoring by external means. It has been designed for use in combined Doppler-inertial systems, but with suitable trimming it is capable of pure inertial navigation for medium time periods.

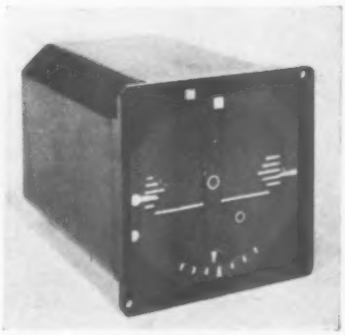
Emphasis has been laid on the use of components thoroughly tested and approved by the Royal Aircraft Establishment. The type 100 platform is fully manœuvrable. It carries three force feedback Kearfott accelerometers, built under licence by Ferranti, and is stabilized by three flotation gyros. The platform is driven through geared servo motors. Attitude and heading information is provided by dual synchros on the gimbals.

Helicopter Flight System

Two years ago Ferranti felt that instrument systems for helicopters had been neglected. As a result they made a thorough survey of the requirements before approaching the Ministry, which has given the department a contract to develop a director horizon. The survey also showed the need for a situation display. Both instruments are described below.

In the Ferranti system the necessary flight information is presented to the pilot on two panel-mounted displays, a director horizon and a hover and navigation display. They will allow the pilot to monitor any automatic flight-control system which may be in operation and to take directed manual control if there should be a failure of the automatics. In addition, the Ferranti system will allow helicopter pilots to learn and practise advanced instrument flying.

The director horizon is a single instrument which gives both attitude information and flight director signals. The artificial horizon, which gives attitude information, has certain special features. It has a larger dial than normal so that it will give a highly sensitive indication of changes in helicopter attitude



DIRECTOR HORIZON.—As described in the text, the Ferranti director horizon gives both helicopter attitude information and flight-director signals.

without the need for making the instrument itself unduly sensitive.

Another special feature is a pitch-angle scale on the instrument. This has been provided because the attitude of a helicopter in pitch can vary by 20° over the range of normal cruising speeds and it is necessary to maintain any attitude in this range without difficulty. The pitch-scale presentation can be varied to meet requirements for different helicopters.

Flight-director requirements are shown as demands for movement of the helicopter's cyclic-pitch, collective-pitch and rudder controls. This is a different approach to that used for fixed-wing aircraft, where the flight-director information is provided as aircraft-attitude demands rather than control-position demands. Because of the characteristics of the helicopter during hovering flight, it cannot be flown accurately with an attitude-demand system.

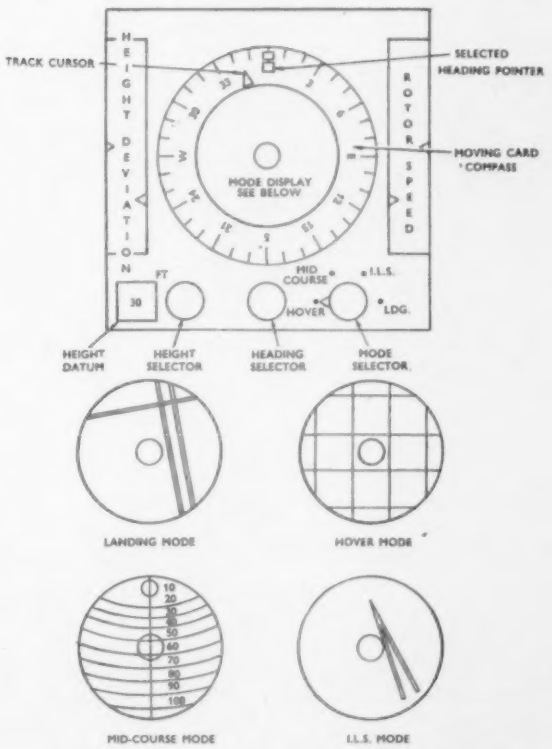
In the Ferranti director horizon the demands for lateral- and longitudinal-control movements of the cyclic-pitch stick have been combined. An index ring at the intersection of two cross wires moves up and down for longitudinal demand and from side to side for lateral demands. A fixed ring provides a datum for the index ring. By appropriate movement of the cyclic-pitch stick the index ring is kept centred on the datum, and in this case the helicopter will take up and maintain the selected flight path.

During cruising flight, demands for longitudinal cyclic control will be received from either the altimeter or airspeed indicator, and lateral demands either from the compass or radio beam. ILS localizer and glide-slope signals can be coupled to this index during a landing approach. It can also be used for the approach to hovering flight and for control during the hover.

Requirements for collective-pitch changes and rudder movement are also shown on the director horizon, but during cruising flight above the minimum-power speed these indices on the director horizon would not normally be in use. Below this speed these demands are of great value in controlling the flight path.

The collective-pitch demand receives signals from the altimeter, vertical-speed indicator or a glide-slope transmission. The compass or a radio beam provides signals for the yaw demand. In both cases moving pointers and a fixed datum are aligned when the correct amount of control is applied. The yaw-demand pointer has been placed at the top of the instrument so that there is no possibility of its being confused with the roll pointer of the artificial horizon which is at the bottom of the dial. By combining flight director indices and attitude indication, the pilot can compare aircraft demands on a single instrument.

A three-position switch is used with the flight director. When switched to "off" the control-demand indicators are deflected so that they do not distract the pilot when they are not wanted. In the "stabilize" position the control-demand indicators can be used to fly the aircraft if automatic stabilization is inoperative. In the "couple" position the demand indicators are coupled to the facility which is selected on the navigation display. There is a separate switch to engage speed or height holds.



NAVIGATION DISPLAY.—The Ferranti hover and navigation display for helicopters is used in conjunction with the director horizon. The four navigation modes which can be selected are shown below the diagram of the display unit.

The hover and navigation display will combine a moving-card compass, pictorial presentation of radio signals, a height-deviation indicator and a rotor-speed indicator. The compass presentation is on the outer ring of the main dial; it has the conventional moving card, fixed lubber line and heading selector.

Navigation displays for four flight phases can be selected —hover, mid-course guidance, ILS and landing. Information for each mode of operation is displayed inside the compass ring.

In the hover mode a series of squares are shown on the dial; their movement shows pictorially the movement of the ground beneath the helicopter. They are controlled by two-axis Doppler or a similar sensitive navigation system. Quantitative drift guidance is given by a pointer against the compass card which shows the helicopter's track.

On selecting mid-course guidance, the squares of the hover mode are replaced by a pictorial display showing range and bearing from a station. The centre line indicates the bearing on the compass scale and the range is read from a scale on the dial. The full use of this mode depends on a rho-theta

ASSEMBLY AT MOSTON.—Air-conditioned dust-free rooms are used for the assembly of Ferranti gyro instruments.

navigation system, but it can be used for dead-reckoning presentation with the information fed manually into the instrument by a navigator.

On selecting ILS mode a localizer pointer appears. The pictorial presentation shows aircraft position and heading relative to the beam. The height-deviation scale on the left of the display shows glide-slope signals.

In the landing mode a pictorial presentation is given of aircraft position relative to the touch-down point; pointers display angular and lateral displacements and range from the landing point.

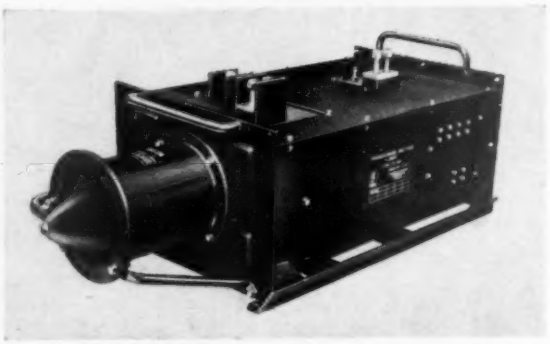
The height-deviation indicator receives signals from a radio or Doppler altimeter; during the hover these give a steady reading with more accuracy than can be gained from a pressure altimeter. The indicator gives deviation relative to a pre-set height; it has a moving pointer and a fixed datum. It has a large scale and can be used as a vertical-speed indicator. Engine or rotor speed information is presented on the right-hand side of the instrument.

Production at Moston

More than 85% of the department's production effort is devoted to gyro instruments—the Mk. 4 series, the FS range of vertical gyros developed from the Mk. 4, and the 3½-in. range of miniature stand-by gyro instruments. These are produced for both civil and military aircraft, missiles and helicopters. All types of instrument are overhauled and repaired if required.

Extreme accuracy and thorough checks at all stages of manufacture are features of Ferranti gyro production. Typical is the accuracy of fit demanded for bearings. Their housings are machined to within a tolerance of 0.0002 in.; inside this tolerance the housings are graded in five sizes. The bearings are similarly graded.

The instruments are assembled in air-conditioned, dust-free rooms. After the gyros have been assembled they are balanced and given a 12-hour run to settle the bearings. They rotate at 23,000 r.p.m. After the test their run-down time is checked; the minimum acceptable time is 7½ minutes, and in practice they average 10-12 minutes. After a gyro has been in service for some while its run-down time can increase to 20 minutes.



FERRANTI T.R.U.—This transformer-rectifier unit has been developed for the Vickers Vanguard; Ferranti T.R.U.s will also be used on the VC10.

The completed instruments also go through an exhaustive series of tests before they are hermetically sealed in their cases. The cases are evacuated and filled with an 80%-20% mixture of helium and nitrogen. When sealed the gyros use less power and have a lower temperature rise when running. Missile gyros are rigorously tested. A drop test, simulating launch-boost separation, is a feature of the programme.

Kearfott accelerometers are assembled and tested under carefully controlled conditions; in the test room the temperature is kept constant to within 3° F. and humidity is rigidly controlled.

With its excellent facilities at Moston and the new developments in hand at Bracknell, the Ferranti aircraft equipment department is well placed to diversify its activities. It has successfully broken into new fields against stiff opposition, and these successes will doubtless be repeated in future.

Industry Record

Comet Crew Comfort

Variants of the D.H. Comet 4 in service throughout the World are being fitted with cockpit heated foot mats developed and manufactured by Inferation, Ltd., of Camberley, Surrey. Varying in size and shape according to the four or five individual flight crew positions, these mats are designed to raise the immediate floor temperature from −10° C. to +27° C. and are fitted flush on to the existing cockpit flooring and bolted in position.

Approximately ¼ in. thick, the mats consist of a pressed-out light alloy skin on the under side of which is bonded an Inferation Element. The remaining volume is filled with a water and fire-proof rigid foam, and the skin is covered with either Aerowalk or rubber matting.

Power requirements for each mat vary between 18 and 36 watts, depending upon the surface area. But the average loading can be between ¼ and 30 watts per sq. ft., according to the heat dissipation required. The approximate weight of a complete mat is ¼ lb. per sq. ft.

The Inferation Element for these mats, and other aircraft applications, such as heated containers and de-icing, is a completely insulated plastic element designed to distribute heat evenly over a given surface. It consists of silverized carbon coated on to glass-fibre cloth, which is then laminated on each side with a further layer of glass-fibre cloth to form an unbreakable plastic sheet. Termination of the element is made by bus-bars fitted with either wire pigtails or a copper strip.

Apart from the surface area of the element, the density and thickness of the silverized carbon coating provides the required heating factor. Stated to be entirely free from electrical breakdown, the element can be cut or holes drilled in it without affecting its overall performance, although there is a heat build-up around the edge of the aperture.

During manufacture the element can be moulded to almost any shape or contour so that it can be fitted into a wide range of equipment. It can also be produced in either a completely rigid or semi-flexible form and made waterproof. Electrical tolerances of the element conform to British Standards and it is also A.R.B. approved.

In addition to the Comet, Inferation, Ltd., are supplying similar cockpit heated foot mats for the Handley Page Herald. The company, which has undertaken aircraft de-icing and anti-icing problems for a number of years, is also developing heated liquid and solid food containers and in-flight ovens.

Aircraft Electrical Equipment

A 64-page illustrated brochure on aircraft equipment has recently been published by the Aircraft Equipment Group of Associated Electrical Industries, Ltd.

It covers AC and DC power systems, ignition equipment, control, starting gear and power generation and utilization equipment. A section is also devoted to electronic ignition testers, electronic leak detectors, semiconductor rectifiers, mobile test sets, and lamps and lighting.

Copies are available on application to the Group's publicity department at Rugby.

Aviation Calendar

Aug. 27

Luton Airport.—Luton Flying Club Aerial Day, at 15.00 hrs.

Aug. 28

Kidlington.—"At Home" Tea Patrol organized by the Oxford Aeroplane Club.

Aug. 29

London.—European Congress of Aviation Medicine on "Human Problems of Supersonic and Hypersonic Flight"; until Sept. 2.

Sept. 1

London.—Society of Instrument Technology and British Interplanetary Society Symposium on "Rocket and Satellite Instrumentation," at Manson House, 26 Portland Place, W.1.

Sept. 5

Farnborough.—S.B.A.C. Air Show; until Sept. 11.

Sept. 8

Varenna, Italy.—AGARD and Lomard Institute of Science and Letters Seminar on "Propulsion for Astronautics"; until Sept. 12.

Sept. 9

Cranfield.—International Rally organized by the Popular Flying Association; until Sept. 12.

Sept. 14

London.—Ultra Anniversary lecture, "The Evolution of Instrumentation," by Prof. A. Porter, in the Recital Room, Royal Festival Hall.

Sept. 16

Oxford.—Institute of Transport Week-end Course at New College; until Sept. 19.

Sept. 17

Battle of Britain "At Home" day. Twenty-five R.A.F. stations open to the public.

Sept. 25

Dunstable Downs.—National Aerobatic Contest organized by the London Gliding Club, at 11.00 hrs.

Sept. 27

London.—The Institution of Mechanical Engineers Symposium on Automatic Control; until Sept. 28.

New Patents

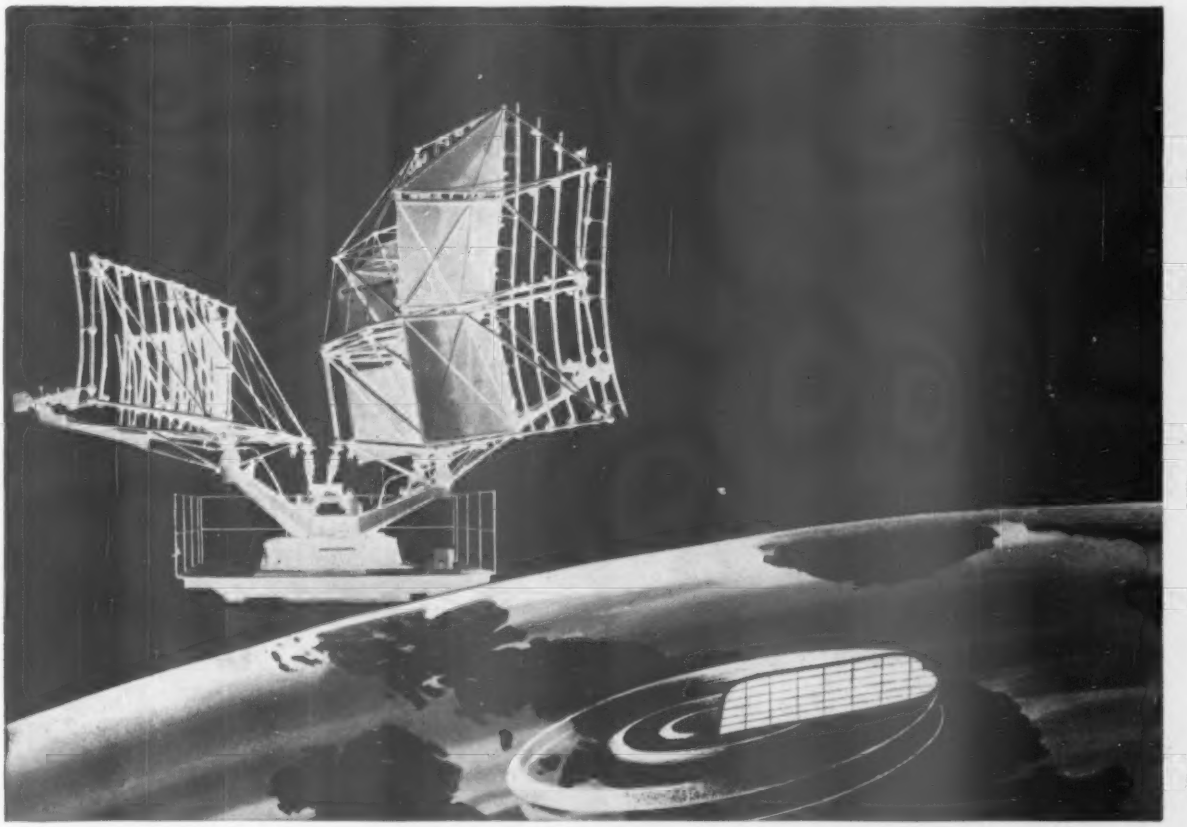
APPLICATIONS ACCEPTED

850,714.—**Soc. de Brevets H.D.**—"Aircraft having wings provided with flaps."—May 30, 1958. (June 4, 1957.)

850,691.—**Power Jets (Research and Development), Ltd.**—"Aircraft engine nacelle structures."—Apr. 22, 1958. (May 14, 1957.)

Printed specifications of the above will be available on Oct. 5, 1960, and the opposition period will expire on Jan. 5, 1961.

HIGH DEFINITION AND GAP FREE COVERAGE



DECCA DASR-1 surveillance radar

The Decca 10 cm. DASR-1 is already in service yielding results which establish its supremacy as the ideal air surveillance radar for jet age operation.

Proved gap free coverage to over 120 miles at 40,000 feet, combined with outstanding definition and clarity in the radar picture, makes the radar easy to operate and ensures safety of air traffic control. On the displays aircraft appear as bright sharp echoes under all weather conditions, with well defined trails giving continuous and accurate indication of direction of movement, alterations of heading and relative speed.

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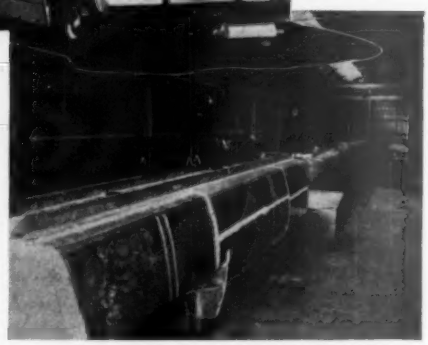

Super Refueller will carry 10,000 Imperial Gallons

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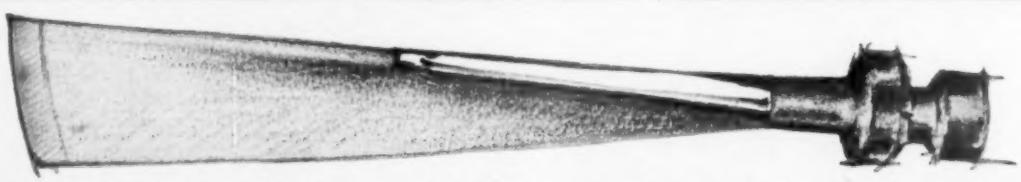
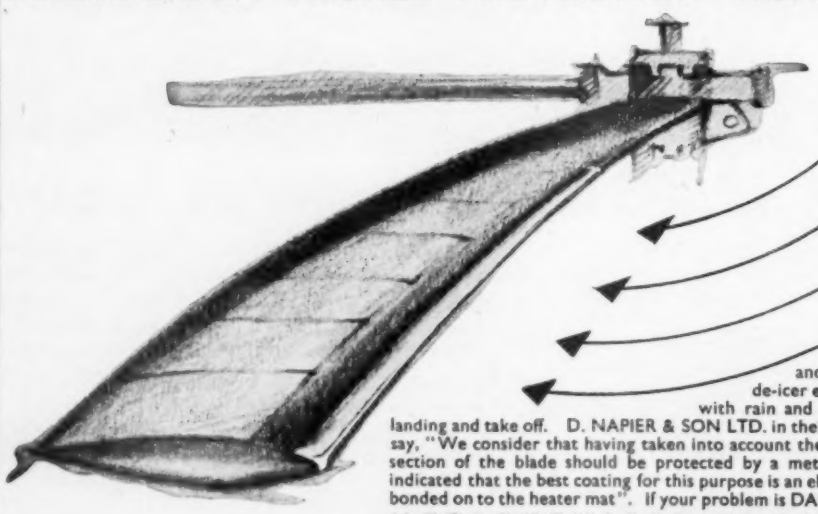


MICROGRAIN NICKEL PROTECTION AGAINST **DAMAGE**



Electroforms of Micrograin nickel on the leading edges of aircraft propellers and helicopter rotors protect the delicate de-icer elements against rupture due to impact with rain and hail in flight or with stones during landing and take off. D. NAPIER & SON LTD. in their Spraymat information bulletin IB/SII say, "We consider that having taken into account the aircraft forward speed the outboard section of the blade should be protected by a metallic coating. Extensive testing has indicated that the best coating for this purpose is an electroformed Micrograin nickel sheath bonded on to the heater mat". If your problem is DAMAGE, the solution is MICROGRAIN.

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NOTICES

AIR TRANSPORT ADVISORY COUNCIL.

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM STARWAYS, LTD., OF LIVERPOOL AIRPORT, LIVERPOOL, 24:—

APPLICATION NO. 4450 for a Normal Scheduled Service with Dakota and D.C.4 aircraft for the carriage of passengers, supplementary freight and mail on the route Glasgow-Liverpool (opt.)-Cork, at a frequency of 20 return flights weekly for seven years from the opening date of Cork Airport.

FROM BRITISH OVERSEAS CORPORATION OF LONDON AIRPORT, HOUNSLOW, MIDDLESEX:—

APPLICATION NO. 4451 for permission to include an optional traffic stop at Baghdad on Reserve Route No. 1 between London and Sydney.

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air-transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. 549-3

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ETHIOPIA.

THE IMPERIAL ETHIOPIAN AIR FORCE INVITE APPLICATIONS FOR THE FOLLOWING POSTS IN THEIR BASE HARAR MEDA, NEAR ADDIS ABABA.

(1) An instructor in aeronautical electronics, qualified to prepare and deliver lectures to students who have attained the G.C.E. O level in education. The course of instruction shall be of three years' duration, at the end of which time students shall have attained a level at least equal to that normally attained during a two-year standard college course in aeronautical electronics.

(2) An aeronautical electronics technician, qualified to establish and administer appropriate laboratory and workshop programmes according to the above level.

The course of instruction shall include the design, installation and maintenance of aeronautical electronics equipment and devices, both ground and airborne, required to provide air navigation and telecommunications services for modern military aircraft.

All instruction shall be in the English language.

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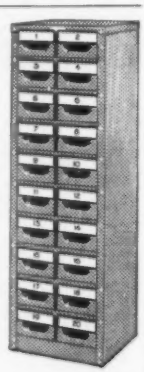

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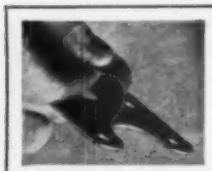
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